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DARK-SPORED AGARICS—V

PSILOCYBE

William A. Murrill

Atylospora and *Psathyrella,* discussed in the last article in this series, are characterized by a slender, cartilaginous stipe, adnate or adnexed lamellae, and a straight, appressed margin. The genus here treated differs from them in having the margin of the pileus incurved at first.

Psilocybe (Fries) Quél. Champ. Jura Vosg. 116. 1872

Agaricus § *Psilocybe* Fries, Syst. Myc. **1**: 289. 1821.

This difficult genus differs from *Atylospora* in having the margin of the pileus incurved when young, and from *Campanularius* in having purplish-brown instead of black spores. See *Mycologia* for January, 1918, where four species occurring in tropical America are described. None of our temperate species seem to grow in tropical regions.

Pileus about 0.5–1 cm. broad.
- Surface reddish-brown; becoming alutaceous on drying. — 1. *P. phyllogena.*
- Surface dull-brownish, then pallid with yellowish spots. — 2. *P. submaculata.*

Pileus about 1–2.5 cm. broad.
- Stipe 1–2.5 cm. long.
  - Surface pallid. — 3. *P. limophila.*
  - Surface brown or yellowish-brown.
    - Plants gregarious or solitary on dead wood. — 4. *P. camptopoda.*
    - Plants densely cespitose on manure and compost. — 5. *P. caespitosa.*

[Mycologia for November (14: 297–350) was issued November 13, 1922.]

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Pileus dark-brown.	
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Spores $12.5–16 \times 7–9\ \mu$.	28. *P. castaneifolia.*
Growing among mosses in swamps.	
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1. PSILOCYBE PHYLLOGENA Peck, Bull. N. Y. State Mus. 157: 99. 1912

Agaricus phyllogenus Peck, Ann. Rep. N. Y. State Mus. 26: 60. 1874.

Agaricus (Hypholoma) modestus Peck, Ann. Rep. N. Y. State Mus. 32: 29. 1879.

Hypholoma phyllogenum Sacc. Syll. Fung. 5: 1042. 1887.

Psathyra conica Peck, Ann. Rep. N. Y. State Mus. 54: 153. 1901.

Psilocybe phyllogena modesta Peck, Bull. N. Y. State Mus. 157: 99. 1912.

Pileus thin, firm, conic or convex, sometimes umbonate, solitary or gregarious, 5–10 mm. broad; surface smooth, glabrous, hygrophanous and reddish-brown when moist, alutaceous or ochraceous when dry, margin incurved, whitened by the remains of a slight veil when young; lamellae adnate, usually with a decurrent tooth, plane, broad, crowded, pallid to purplish-brown, entire and pallid on the edges; spores top-shaped or turnip-shaped, smooth, sometimes apiculate, isabelline with a smoky-purplish-brown tint under the microscope, 6–7 x 5–6 μ; stipe slender, equal, smooth, cartilaginous, silky-fibrillose, hollow, brownish, often expanding at the base into a flat disk, 2–3 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Worcester, New York.

HABITAT: On dead leaves, sticks, and logs of deciduous or coniferous trees.

DISTRIBUTION: New England to the mountains of Virginia.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 54: *pl. H, f. 17–22.*

A very pretty little plant, specimens of which collected by Peck in July are still well preserved at Albany, attached to a sheet containing a sketch. The type specimens of *A. modestus* were collected by Peck at Sandlake in August; while those of *P. conica* were found by him on spruce logs at Floodwood early in September. The spores are quite peculiar, being very broad-shouldered or subtriangular in outline. I found the plant quite common on leaves in woods at Mt. Lake, Virginia, early in July, 1909, and made three collections of it (*77, 91, 177*). Earle got it at Redding, Connecticut, in July, 1902 (*404*); and Mrs. Delafield made notes and a colored sketch from specimens found by her (*82*) at Buck Hill Falls, Pennsylvania, August 15, 1921. In 1910 it

appeared especially early here in the Garden, having been found by me on sticks and trash on June 20.

2. PSILOCYBE SUBMACULATA Atk. Ann. Myc. **7**: 375. 1909

Pileus convex, cespitose, 4–10 mm. broad; surface smooth, hygrophanous, dull-brownish, then dull-white with dark, watery and yellowish spots; margin at first incurved; lamellae adnate, emarginate, rather crowded, brownish with a purple tint, white on the edges; spores suboblong to subellipsoid, slightly inequilateral, purple-brown under the microscope; cystidia few; stipe fistulose, even, somewhat flexuous, subcartilaginous to fleshy, shining-white, white-mealy at the apex, with white mycelium at the base, 2–3 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On very rotten wood in woods.

DISTRIBUTION: Known only from the type locality.

According to Kauffman, Atkinson reported this species from Michigan also. I have not seen any specimens.

3. PSILOCYBE LIMOPHILA (Peck) Sacc. Syll. Fung. **5**: 1048. 1887

Agaricus limophilus Peck, Ann. Rep. N. Y. State Mus. **30**: 42. 1878.

Pileus thin, convex becoming nearly plane, fragile, 1.5–2.5 cm. broad; surface atomaceous, radiately rugulose, whitish, often splitting on the margin, sometimes areolately cracking; lamellae rather broad, subdistant, whitish becoming purplish-brown; spores 10–12 x 5–6 μ; stipe equal, striate and slightly mealy at the apex, hollow, short, white, 2–2.5 cm. long, 1.5–2 mm. thick.

TYPE LOCALITY: Green Island, Albany County, New York.

HABITAT: On muddy alluvial soil under willows.

DISTRIBUTION: Known only from the type locality.

4. PSILOCYBE CAMPTOPODA (Peck) Sacc. Syll. Fung. **5**: 1057. 1887

Agaricus camptopus Peck, Ann. Rep. N. Y. State Mus. **31**: 35. 1879.

Psilocybe unicolor Peck, Ann. Rep. N. Y. State Mus. **53**: 845. 1900.

Psilocybe cavipes House, Bull. N. Y. State Mus. 205–206: 40. 1919.

Pileus thin, broadly convex, gregarious or solitary, 1–2 cm. broad; surface glabrous, hygrophanous, brown and striatulate on the margin when moist, whitish when dry; context white, with a slightly disagreeable taste; lamellae narrow, crowded, adnate or adnexed, whitish becoming brown; spores 6 x 4 μ; stipe equal, straight or curved, glabrous, slightly pruinose or mealy at the apex, paler than the pileus, 1.5–2.5 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Catskill Mountains, New York.

HABITAT: On decorticated decaying logs in woods.

DISTRIBUTION: New York.

Three collections of *P. camptopoda* are at Albany, obtained by Peck at Big Indian, etc. *P. unicolor,* which proves to be the same thing, was collected by Peck in quantity at Savannah, New York, on decaying mossy logs of deciduous trees in October.

5. **Psilocybe caespitosa** sp. nov.

Pileus convex to expanded, often with a broad nipple-like umbo, densely cespitose, 1–2.5 cm. broad; surface smooth, glabrous, hygrophanous to dry, striate over the lamellae when wet, brownish-isabelline to isabelline, the margin incurved and joined to the stipe in young stages by a slight, fibrillose, evanescent veil; context without characteristic odor or taste; lamellae adnate to sinuate, crowded, arcuate, colored like the pileus but with a smoky or purplish tint, beautifully notched on the edges; spores ovoid, smooth, pale-isabelline with a slight purplish tint under the microscope, smoky-purplish-brown in mass, about 7 x 5 μ; stipe subequal, concolorous or paler, darker at the base, shaggy-fibrillose to subglabrous and shining, cartilaginous, fistulose, 1–3 cm. long, 1–2 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: On or near compost heaps and manure piles.

DISTRIBUTION: New York Botanical Garden.

Collected by W. A. Murrill, June 6, 1910 (*type*); also on June 18, 1911, and July 1 and 2, 1915. Found in abundance.

6. PSILOCYBE SABULOSA Peck, Bull. Torrey Club **24**: 144. 1897

Pileus convex, subumbonate, 1.5–2.5 cm. broad; surface glabrous, yellow; lamellae broad, subdistant, ventricose, adnate, becoming purplish-brown, whitish on the edges; spores ellipsoid, 12.5–15 x 7.5 μ; stipe equal, hollow, pallid or straw-colored, 2.5–4 cm. long, 2 mm. thick.

TYPE LOCALITY: Rooks County, Kansas.

HABITAT: On sandy soil in pastures, often growing from clumps of living grass.

DISTRIBUTION: Rooks County, Kansas.

Type specimens were collected by Bartholomew (*2246*) on August 24. He has distributed specimens collected on October 7, 1902. Peck remarks that the umbo in some specimens is quite prominent, while in others it is wholly wanting. *P. arenulina* is said to differ in being hygrophanous and having smaller spores.

7. PSILOCYBE SQUALIDELLA Peck, Ann. Rep. N. Y. State Mus. **46**: 55. 1893

Agaricus squalidellus Peck, Ann. Rep. N. Y. State Mus. **29**: 40. 1878.

Hypholoma squalidellum Sacc. Syll. Fung. **5**: 1041. 1887.

Pileus thin, convex, subconic or subcampanulate, expanded when old, gregarious or cespitose, 1–2.5 cm. broad; surface glabrous, hygrophanous, dark-ochraceous and striatulate on the margin when moist, pale-ochraceous or yellow when dry, spore-stained and squalid when old; lamellae broad, subdistant, rounded behind, adnexed, whitish becoming purplish-brown, with white edges; spores 9–12 x 5–8 μ; stipe slender, stuffed, fibrous, subflexuous, reddish-brown, 2.5–5 cm. long, 2–2.5 mm. thick.

TYPE LOCALITY: Shokan, New York.

HABITAT: On damp ground in woods.

DISTRIBUTION: New York.

According to Peck, this species is abundant on damp, mucky soil in the Adirondack region. It is also quite variable in color and in the shape of the pileus. When moist the latter may be yellow, reddish-yellow, or brown; and when dry either tawny or ochraceous. It is either hemispheric or convex, with the lamellae broad and nearly plane or ventricose. Type specimens of the species and its two varieties, as preserved at Albany, seem quite distinct. Variety *macrosperma* has spores measuring 12–15 x 7–8 μ, and variety *umbonata* has a decided conic umbo. With fresh material at hand, other differences would probably appear.

8. PSILOCYBE POLYCEPHALA (Paulet) Peck, Bull. N. Y. State Mus. 157: 55. 1912

Hypophyllum polycephalum Paulet, Traité Champ. *pl. 111, f. 1, 2;* hyponym. 1812–35.

Agaricus polycephalus Fries, Epicr. Myc. 226. 1838.

Psilocybe spadicea polycephala Sacc. Syll. Fung. 5: 1053. 1887.

Pileus fleshy but thin, subcampanulate to convex or nearly plane, densely gregarious or cespitose, 1–3 cm. broad; surface glabrous, even, hygrophanous, at first whitish with a reddish-yellow center, then darker or brown and striatulate on the margin while moist, paler or whitish when dry; context with a mild taste; lamellae thin, narrow, crowded, adnexed or nearly free, whitish, becoming purplish-brown; spores ellipsoid, purplish-brown, 7–8 x 4–5 μ; stipe equal, straight or flexuous, hollow, glabrous, mealy or pruinose at the apex, white, 2.5–5 cm. long, 2–4 mm. thick.

TYPE LOCALITY: France.

HABITAT: In woods either on the ground about the base of trees or on dead wood.

DISTRIBUTION: New York; also in Europe.

ILLUSTRATIONS: (Paulet & Lév.), Ic. Champ. *pl. 111, f. 1, 2;* Peck, Bull. N. Y. State Mus. 157: *pl. 127, f. 1–9.*

9. PSILOCYBE ATOMATOIDES (Peck) Sacc. Syll. Fung. 5: 1048. 1887

Agaricus atomatoides Peck, Ann. Rep. N. Y. State Mus. 29: 41. 1878.

Pileus thin, fragile, convex or subcampanulate becoming nearly plane, solitary or gregarious, 1.5–2.5 cm. broad; surface rugose, atomate, slightly and evanescently white-floccose, slightly hygrophanous, grayish or ochraceous-brown, sometimes with a pinkish tint; context mild, cinereous; lamellae moderately broad, subventricose, rounded behind, adnexed, cinereous becoming dark-brown; spores blackish-brown, 7–8 x 4–5 μ; stipe equal, hollow, minutely flocculent when young, pruinose at the apex, whitish, 3–5 cm. long, 2 mm. thick.

TYPE LOCALITY: West Albany, New York.

HABITAT: On the ground and on decaying wood under pine trees.

DISTRIBUTION: New York, New Jersey, Pennsylvania, and Alabama.

The type specimens were collected by Peck in June. There are two other collections at Albany. I have it from Fort Lee, New Jersey, collected by Earle (*1405*) on September 15, 1902; from Buck Hill Falls, Pennsylvania, collected twice in August by Mrs. Delafield; from Whitestone, Long Island, collected on September 28 by Mrs. Irving; and from near Bronx Park, collected by myself on September 26. The spores in these last specimens are narrowly ellipsoid, smooth, dark-bay under the microscope, opaque, about 9 x 5 μ. The species seems to lie on the border line between *Psilocybe* and *Psathyrella.*

Specimens collected by Earle, March 9, 1900, on burned ground in pine woods at Auburn, Alabama, scarcely differ from recent New York specimens except in having somewhat smaller spores. They may be described as follows:

Pileus convex, not umbonate and not fully expanding, gregarious, 1–2 cm. broad; surface light-brown, reminding one of a mixture of milk and coffee, smooth and subshining at maturity, clothed when young with long, white hairs that extend downward to the edge, forming a sort of veil, disappearing at an early stage from the disk but remaining until maturity on the incurved margin as a sort of fringe; lamellae adnate, subcrowded, rather narrow, whitish or pallid, becoming dark-brown, with white, entire edges; spores ellipsoid, sometimes curved, rounded at both ends, smooth, dark-purplish-brown under the microscope, about 7 × 3.5 μ; stipe equal, pallid, paler than the pileus, hollow, clothed with white hairs when young and usually fibrillose-scaly, about 3 cm. long and 2–3 mm. thick.

Specimens collected by me, July 9, 1915, on a rotten deciduous stick in the New York Botanical Garden and colored by Miss Eaton were pale-fumose with long, dense, shaggy-fibrillose scales of the same color on pileus and stipe; spores dark-bay, about 9 x 5.5 μ; spore-print almost black. The plant was very delicate and fragile, and the fibrils mostly collapsed soon after picking.

10. PSILOCYBE ARENULINA (Peck) Sacc. Syll. Fung. 5: 1057. 1887

Agaricus arenulinus Peck, Ann. Rep. N. Y. State Mus. 30: 42. 1878.

Pileus convex becoming plane or centrally depressed, rarely umbonate, gregarious, 1–3 cm. broad; surface glabrous, hygrophanous, dark-brown and coarsely striate on the margin when moist, dingy-white when dry; lamellae crowded, adnate, cinnamon-brown,

becoming darker or purplish-brown; spores ellipsoid, smooth, purplish-brown, 10–12 x 5–6 μ; stipe slightly tapering upward, hollow. often radicate and somewhat clavate at the base, whitish, 3–5 cm. long, 1.5–2 mm. thick.

TYPE LOCALITY: West Albany, New York.

HABITAT: In sandy soil.

DISTRIBUTION: New York and Michigan.

The type specimens and also some from Karner are to be seen at Albany. Peck has written on the sheet "Perhaps *ammophilus,*" but gives reasons for keeping it distinct. Kauffman reports it from Michigan and remarks that it is near *P. ammophila* Mont., but that his plants were not like those figured by Hard on page 330 of his book.

11. PSILOCYBE AGRARIELLA Atk. Ann. Myc. 7: 374. 1909

Pileus thin, convex to expanded, gregarious, 1–2.5 cm. broad; surface hygrophanous, pellucid, striate when moist or slightly rugose, pale-reddish-brown or pale-rufous, drying pale-subochraceous to buff or pinkish-buff; lamellae adnate, dull-purplish-brown, with white edges; spores subellipsoid, smooth, purplish-brown under the microscope, 7–9 x 4–5.5 μ; cystidia lanceolate, 50–65 x 12–15 μ; stipe flexuous, mealy, hollow, rather fragile, concolorous below, shining-white above, whitish-mycelioid at the base, 4–6 cm. long, about 3 mm. thick.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On the ground in woods.

DISTRIBUTION: New York and Michigan.

Kauffman reports this species from two localities in Michigan and says that it differs from *P. cernua* in having a slight veil when young. I have not seen his specimens or the types.

12. PSILOCYBE CAERULIPES (Peck) Sacc. Syll. Fung. 5: 1051. 1887

Agaricus caerulipes Peck, Ann. Rep. N. Y. State Mus. 38: 89. 1885.

Pileus thin, subcampanulate becoming convex, obtuse or obtusely umbonate, cespitose or solitary, 1–2 cm. broad; surface glabrous, hygrophanous, slightly viscid, brown and striatulate on the margin when moist, yellowish or subochraceous when dry, the

center sometimes brownish; lamellae at first ascending, crowded, adnate, grayish-tawny becoming rusty-brown, whitish on the edges; spores 8–10 x 4–5 μ; stipe slender, equal, flexuous, tenacious, hollow or containing a separable pith, slightly fibrillose, pruinose at the apex, bluish, sometimes whitish above, 2.5–4 cm. long, 1–1.5 mm. thick.

TYPE LOCALITY: South Ballston, New York.

HABITAT: On decaying wood.

DISTRIBUTION: New York.

Specimens are to be seen at Albany from two or three New York localities, all agreeing with the types.

13. **Psilocybe latispora** sp. nov.

Pileus convex to expanded, obtuse or umbonate, gregarious, 1–1.5 cm. broad; surface glabrous, hygrophanous, dark-fuscous and substriate on the margin when moist, becoming ochraceous on drying; context concolorous, with mild but mawkish taste; lamellae adnate, subcrowded, broad, pallid to dark-fuscous; spores very broadly ovoid to subglobose, smooth, pale-smoky-purplish-brown under the microscope, about 7 x 5.5 μ; stipe equal, fuscous, pruinose at the apex, fibrillose below, fistulose, 2–3 cm. long, 1–2 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: Along roadsides.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*1462*) on June 25, 1903. This species has unusually broad spores for the genus.

14. PSILOCYBE CASTANELLA Peck, Bull. N. Y. State Mus. 1^2: 7. 1888

Pileus thin, convex or subconic becoming plane or slightly depressed in the center, gregarious or subcespitose, 8–16 mm. broad; surface glabrous, hygrophanous, chestnut or umber-brown and striatulate on the margin when moist, pale-alutaceous when dry; context paler than the surface; lamellae crowded, adnate or slightly rounded behind, pale-brown becoming purplish-brown; spores ellipsoid, purplish-brown, 8–10 x 4–5 μ; stipe equal, flexuous, hollow or stuffed with a whitish pith, slightly silky-fibrillose, brownish or subrufescent with white mycelium at the base, 2.5–5 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Sandlake, New York.

HABITAT: In rich grassy ground by roadsides.

DISTRIBUTION: Known only from the type locality.

The type specimens are well preserved at Albany.

15. PSILOCYBE OBSCURA Peck, Bull. Torrey Club 24: 144. 1897

Pileus thin, convex, 1–2 cm. broad; surface hygrophanous, striate, more or less flecked or scurfy with a white, floccose tomentum, brown or reddish-brown; lamellae broad, subdistant, adnate, brown, becoming almost black, whitish-flocculent on the edges; spores ellipsoid, 10–13 x 6–8 μ; stipe slender, hollow, a little paler than the pileus, whitish-tomentose at the base, 2.5–4 cm. long, 2 mm. thick.

TYPE LOCALITY: Kansas.

HABITAT: On rich leaf-mold in woods.

DISTRIBUTION: Known only from the type locality.

The type specimens were collected by Bartholomew.

16. **Psilocybe vialis** sp. nov.

Pileus thin, convex to expanded, gregarious to cespitose, 1–3 cm. broad; surface glabrous, hygrophanous, dark-brown when moist, becoming light-brown when dry, the margin at length striate; context brown with somewhat unpleasant taste; lamellae adnate, crowded, plane, rosy-isabelline to dark-brown; spores ovoid, tapering at both ends, smooth, often guttulate, pale-yellowish under the microscope, about 7–8 x 3.5–4.5 μ; stipe equal, hollow, subfibrillose, concolorous, 4–6 cm. long, 2–4 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: Along roadsides.

DISTRIBUTION: Known only from the type locality.

Type collected by F. S. Earle (*725*) on July 27, 1902.

17. PSILOCYBE ELONGATIPES (Peck) Sacc. Syll. Fung. 5: 1046. 1887

Agaricus elongatipes Peck, Ann. Rep. N. Y. State Mus. 29: 40. 1878.

Pileus thin, convex becoming nearly plane, gregarious, 1–2.5 cm. broad; surface glabrous, moist, yellow; lamellae broad, subdistant, ventricose, yellowish becoming brown, usually whitish on the edges; spores ellipsoid, 10–12 x 6–8 μ; stipe elongate, fragile, flexuous, stuffed or hollow, slightly silky-fibrillose, pallid or reddish, 7–12 cm. long, 1.5–2 mm. thick.

TYPE LOCALITY: Greig, New York.

HABITAT: Among sphagnum in marshes and wet places in woods.

DISTRIBUTION: New York.

Plenty of New York material may be seen at Albany. Karner is one of the localities.

18. **Psilocybe Cokeri** sp. nov.

Pileus convex to campanulate, not fully expanding, solitary to gregarious, reaching 2.5 cm. broad; surface glabrous, light-grayish-tan, slightly striate on the margin, which is incurved in young stages; lamellae adnate, rather broad, subcrowded, smoky-brown, becoming darker with age; spores ellipsoid, smooth, purplish-brown in mass, 7–8 x 4 μ; stipe equal, smooth, subcartilaginous, hollow, whitish to dirty-pallid-flesh-colored, 5–7 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Chapel Hill, North Carolina.

HABITAT: In low, moist soil mixed with humus.

DISTRIBUTION: Known only from the type locality.

The specimens were collected on October 24, 1912, by W. B. Cobb and studied by Dr. Coker (*621*), who sent them to me for determination. When they were a day old, they appeared somewhat deliquescent, suggesting *Coprinus*.

19. **Psilocybe panaeoliformis** sp. nov.

Pileus strongly convex or subcampanulate, only partly expanding with age, solitary to cespitose, reaching 2.5 cm. broad; surface dry, slightly fibrillose to glabrous, dull-grayish-brown; lamellae strongly sinuate or adnexed, sometimes nearly free, ventricose, broad, crowded, dark-gray or tawny to blackish; spores broadly ellipsoid to ovoid, pointed at both ends at times, smooth, olivaceous with a purplish tint under the microscope, about 9 x 7 μ; stipe very slender, equal, slightly fibrillose to glabrous, cartilaginous, hollow, darker than the pileus, 5–10 cm. long, 1–2 mm. thick.

TYPE LOCALITY: Biloxi, Mississippi.

HABITAT: On manure or manured ground.

DISTRIBUTION: Mississippi and Alabama.

The type specimens were collected by Mrs. F. S. Earle on September 2, 1904. Also collected by F. S. Earle at Auburn,

Alabama, October 14, 1900. The aspect of the plant is that of *Panaeolus,* but the spores are very distinct.

20. PSILOCYBE FOENISECII (Pers.) Quél. Champ. Jura Vosg. 117. 1872

Agaricus foenisecii Pers. Ic. Descr. Fung. 42. 1800.

Pileus conic or campanulate to convex, solitary or gregarious, 1–2.5 cm. broad; surface glabrous, hygrophanous, smoky-brown or reddish-brown, paler when dry, often variegated; context thin, dingy-pallid, without characteristic odor or taste; lamellae adnate or somewhat sinuate, ventricose, broad, not crowded, purplish-fuscous or fuscous-brown, variegated, whitish on the edges; spores ovoid or broadly ellipsoid, smooth or very slightly tuberculate, umbrinous under the microscope, apiculate, about 12 x 7 μ, often reaching 17.5 x 12 μ, very variable in size; stipe slender, equal, hollow, fragile, glabrous or slightly pruinose, pallid to brownish, 5–8 cm. long, 2 mm. thick.

TYPE LOCALITY: Germany.

HABITAT: On lawns or among grass in fields.

DISTRIBUTION: New England to Alabama and west to Wisconsin; also in Europe.

ILLUSTRATIONS: Berk. Outl. Brit. Fungol. *pl. 11, f. 5;* Bull. N. Y. State Mus. 75: *pl. 86, f. 1–11;* Cooke, Brit. Fungi *pl. 608* (*590*); Gill. Champ. Fr. *pl. 592* (*133*); Hard, Mushr. *f. 267;* Hussey, Ill. Brit. Myc. 1: *pl. 39, f. 3;* Mycologia 3: *pl. 40, f. 5;* Pers. Ic. Descr. Fung. *pl. 11, f. 1;* Ricken, Blätterp. Deutschl. *pl. 66, f. 8.*

21. PSILOCYBE SENEX Peck, Ann. Rep. N. Y. State Mus. 41: 70. 1888

Pileus thin, hemispheric, obtuse, 1–2 cm. broad; surface hygrophanous, dark-brown and striatulate on the margin when moist, pale-cinereous and shining when dry, slightly squamulose with superficial, subfasciculate, whitish fibrils, the margin sometimes appearing slightly and fugaciously appendiculate with these fibrils; lamellae broad, subdistant, adnate, grayish or cinereous, becoming brown or blackish-brown, white on the edges; spores brown, 8 x 5 μ; stipe slender, hollow, fragile, floccosely pruinose, white, 3–7 cm. long, 2 mm. thick.

TYPE LOCALITY: Catskill Mountains, New York.

HABITAT: On decaying wood in woods.

DISTRIBUTION: New York and Pennsylvania.

The type specimens collected by Peck are attached to a herbarium sheet and are rather scanty. I found the species in August, 1917, at Delaware Water Gap.

22. PSILOCYBE LIMICOLA (Peck) Sacc. Syll. Fung. **5**: 1054. 1887

Agaricus limicola Peck, Ann. Rep. N. Y. State Mus. **24**: 70. 1872.

Pileus thin, convex becoming nearly plane, gregarious or cespitose, 1.2–5 cm. broad; surface glabrous, hygrophanous, dark-brown and striatulate on the margin when moist, pale-ochraceous-brown and rugose when dry; lamellae crowded, rounded behind, adnexed, cinnamon-brown, darker when old; spores ellipsoid, 10–12 x 6–8 μ; stipe slender, equal, brittle, silky, hollow above, stuffed below, whitish, 3–8 cm. long, 1.5–3 mm. thick.

TYPE LOCALITY: Greig, New York.

HABITAT: On damp, muck soil in woods.

DISTRIBUTION: New York.

ILLUSTRATION: Ann. Rep. N. Y. State Mus. **24**: *pl. 2, f. 9–13.*

Excellent type specimens are to be seen at Albany, collected by Peck in September. Other specimens are from Horse Shoe Pond.

23. PSILOCYBE CONISSANS Peck, Bull. N. Y. State Mus. **122**: 131. 1908

Clitopilus conissans Peck, Ann. Rep. N. Y. State Mus. **41**: 64. 1888.

Pileus fleshy but thin, broadly convex becoming nearly plane, cespitose, 2.5–5 cm. broad; surface glabrous, hygrophanous, pale-chestnut or ferruginous and striatulate on the margin when moist, pale-alutaceous or pale-buff and sometimes slightly rugose when dry; context thin, whitish, mild; lamellae thin, crowded, rounded behind, adnexed or rarely adnate, bay verging to dark-purple or liver-colored; spores ellipsoid, smooth, hyaline with a reddish tint under the microscope, brick-red or vinaceous in mass, 8–10 x 4–5 μ; stipe equal, rather slender, firm, cartilaginous, glabrous, hollow, curved or flexuous, white and somewhat floccose above, darker below, 2.5–5 cm. long, 2–4 mm. thick.

TYPE LOCALITY: Catskill Mountains, New York.

HABITAT: In humus, especially at the base of trees.

DISTRIBUTION: Maine, New York, Pennsylvania, and Michigan.

Peck found his plants growing in a cluster at the base of an apple tree; Earle got the species at the base of an oak in the New York Botanical Garden; and Miss White found it in Maine at the foot of a maple. I have specimens also from Chappaqua, New York, collected by Mrs. Murrill, and from Buck Hill Falls, Pennsylvania, collected by Mrs. Delafield. It is a very attractive and interesting plant—one never forgets the color of the gills. Peck placed it first in *Clitopilus*, but thought it suggested *Hypholoma* or *Psilocybe*, and afterwards transferred it to the latter genus. The spores are almost hyaline under the microscope—a very peculiar character for *Psilocybe*—but brick-red or purplish in mass, and the general appearance of the hymenophore is much more like *Psilocybe* than *Clitopilus*.

24. PSILOCYBE FUSCOFOLIA Peck, Bull. N. Y. State Mus. 157: 100. 1912

Pileus fleshy, thin, conic or hemispheric, becoming convex-plane or centrally depressed, solitary, gregarious or cespitose, 2.5–5 cm. broad; surface glabrous, hygrophanous, alutaceous when moist, subochraceous and rugose when dry; margin even, incurved; context whitish or yellowish; lamellae narrow, thin, crowded, adnate, sometimes forked, pale-brown becoming reddish-brown; spores ellipsoid, brown, 6–8 x 3–4 μ; stipe equal, slender, hollow, silky-fibrillose, white, thickened or subbulbous and whitish-mycelioid at the base, 2.5–4 cm. long, 2–4 mm. thick.

TYPE LOCALITY: New York City.

HABITAT: On soil or on decaying wood in woods or in open places.

DISTRIBUTION: Vicinity of New York City.

25. PSILOCYBE CYSTIDIOSA Peck, Bull. N. Y. State Mus. 167: 46. 1913

Pileus thin, convex or subconic, solitary or cespitose, 2–4 cm. broad; surface hygrophanous, glabrous, pale-brown when moist, yellowish-drab with a brownish center and sometimes obscurely striate on the margin when dry, becoming lacerate at times when expanded; context white with a nutty taste; lamellae adnate, crowded, thin, whitish becoming purplish-brown; spores ellipsoid, purplish-brown, 8–10 x 5–6 μ; cystidia 60–80 x 12–20 μ; stipe

equal or slightly tapering upward, hollow, pruinose at the top, white, often with a subglobose mass of earth adhering to the base, 4–5 cm. long, 2–4 mm. thick.

TYPE LOCALITY: Minneapolis, Minnesota.

HABITAT: On the ground.

DISTRIBUTION: Known only from the type locality.

26. PSILOCYBE SUBAGRARIA Atk. Ann. Myc. 7: 375. 1909

Pileus convex to expanded, sometimes subumbonate, 3–5 cm. broad; surface silky, gray to drab; lamellae elliptic, adnexed, emarginate, white, then rose to gray, and finally brown with a purple tint, white on the edges; spores suboblong to subellipsoid, slightly inequilateral, smooth, purplish-brown, 8–10 x 4–5 μ; cystidia hyaline, clavate, 45–55 x 12–15 μ; stipe fibrous-striate, white with a gray tint, fistulose, subcartilaginous to fleshy, soft, shining, pruinose or silky-fibrillose, 6–8 cm. long, 4–5 mm. thick.

TYPE LOCALITY: Ithaca, New York.

HABITAT: On the ground in woods.

DISTRIBUTION: Known only from the type locality.

I have not seen the type specimens.

27. PSILOCYBE SPADICEA (Schaeff.) Quél. Champ. Jura Vosg. 239. 1872

Agaricus spadiceus Schaeff. Fung. Bavar. Ind. 27. 1774. Not *A. spadiceus* Scop. 1772.

Pileus fleshy, rigid, convex becoming nearly plane, obtuse, commonly cespitose, 2.5–6 cm. broad; surface scabrous, even, hygrophanous, bay or bay-brown when moist, pallid when dry; lamellae crowded, rounded behind, adnexed, dry, whitish becoming pinkish-brown; spores brown, 8–9 x 4–5 μ; stipe equal, rather tough, glabrous, hollow, even at the apex, whitish, 5–8 cm. long, 4–6 mm. thick.

TYPE LOCALITY: Bavaria.

HABITAT: On the ground among fallen leaves or on and about the base of trees.

DISTRIBUTION: Eastern United States as far south as North Carolina; also in Europe.

ILLUSTRATIONS: Cooke, Brit. Fungi *pl. 606 (610)*; Ricken, Blätterp. Deutschl. *pl. 66, f. 7;* Schaeff. Fung. Bavar. *pl. 60, f. 4–6.*

The name used above is preoccupied by *A. spadiceus* Scop., and it will require considerable time to find a synonym that is tenable. Several New York collections at Albany, from Ampersand and elsewhere, agree fairly well with specimens collected by me at Norrköping, Sweden, and named by Romell; while other specimens so named by Peck seem quite distinct and are more like what I found at Kew under this name.

28. **Psilocybe castaneifolia** sp. nov.

Pileus fleshy, rather thick, convex, not fully expanding, gregarious, 2–4 cm. broad; surface strongly hygrophanous, often rugose, dark-fuliginous when moist, pale-ochraceous and somewhat zoned when dry, margin even and incurved; context fuliginous when moist, pallid when dry, with rather strong odor and unpleasant taste; lamellae adnexed, broad, triangular or ventricose, not crowded, pallid to dark-fuscous or castaneous with whitish edges; spores ellipsoid, granular, apiculate, pale-bay under the microscope, dark-smoky-purplish-brown in mass, 12.5–16 x 7–9 μ; stipe slightly tapering downward, pruinose, subconcolorous to pale-ochraceous, cartilaginous, fistulose, 4–6 cm. long, 4–6 mm. thick.

TYPE LOCALITY: New York Botanical Garden, New York City.

HABITAT: On roadsides and in grassy fields.

DISTRIBUTION: New York City.

Type collected by F. S. Earle (*1442*) on June 14, 1903, and studied in the fresh condition. The dried specimens have chestnut-colored lamellae, which character distinguishes it at once from plants like *Psilocybe spadicea* and from species of *Stropharia* having spores of this size.

29. PSILOCYBE NIGRELLA Peck, Bull. N. Y. State Mus. 139: 28. 1910

Pileus thin, broadly convex becoming nearly plane, slightly umbonate, scattered or gregarious, 2.5–4 cm. broad; surface hygrophanous, seal-brown, shining and even or obscurely striate on the margin when moist, raw-umber or mummy-brown when dry; lamellae thin, rather crowded, rounded behind, adnexed, purplish-brown or seal-brown, whitish on the edges; spores ellipsoid, dark-purplish-brown, almost black, 10–12 x 6–8 μ; stipe firm, rigid, equal, stuffed with a slender white pith, silky-fibrillose, whitish, 3.5–7 cm. long, 2.5 mm. thick.

TYPE LOCALITY: Karner, New York.

HABITAT: On damp, mossy ground in swamps.

DISTRIBUTION: New York and Massachusetts.

ILLUSTRATION: Bull. N. Y. State Mus. 139: *pl. 3, f. 7–11.*

Plants labeled *Naucoria nigrella,* collected by Morris at Natick, Massachusetts, October 13, 1909, appear to be this species. The spores are ellipsoid, tapering at both ends, smooth, purplish-brown under the microscope, 8–10 x 5–6 μ.

30. PSILOCYBE UDA (Pers.) Gill. Champ. Fr. 586. 1878

Agaricus udus Pers. Syn. Fung. 414. 1801.

Pileus fleshy, thin, convex becoming plane, gregarious, 2–3 cm. broad; surface rugulose, at least when dry, tawny-bay becoming yellowish; lamellae subdistant, adnexed, ventricose, whitish becoming purplish-brown; spores purplish-brown, 16–20 x 7–9 μ; stipe equal, elongate, thin, tough, fibrillose, hollow, straight, sometimes slightly wavy, pale above, ferruginous below, 5–8 cm. long, 2–3 mm. thick.

TYPE LOCALITY: Europe.

HABITAT: Among sphagnum and other mosses or grasses.

DISTRIBUTION: Northeastern United States; also in Europe.

ILLUSTRATION: Cooke, Brit. Fungi *pl. 569 (594).*

Peck's specimens, taken from a sphagnum swamp in New York, and Morris's specimens collected at Natick, Massachusetts, in October, 1907, appear to agree well with specimens from Bresadola and some recently collected by Romell in Sweden. See Kauffman's book, p. 277, for notes on variety *elongata.*

31. PSILOCYBE DICHROA (Pers.) P. Karst. Bidr. Finl. Nat. Folk 32: 504. 1879

Agaricus dichrous Pers. Syn. Fung. 343. 1801.

Psilocybe fuscofulva Peck, Bull. N. Y. State Mus. 1[2]: 7. 1888.

Pileus thin, fleshy, conic or campanulate becoming convex, subumbonate, solitary, 2–3.5 cm. broad; surface glabrous, subviscid, subshining, striatulate on the margin, brown or bay-brown, subalutaceous in dry weather; lamellae broad, subcrowded, adnate or adnexed, ventricose, pallid becoming purplish-brown, whitish on the edges; spores purplish-brown, 10–12 x 6–8 μ; stipe equal or slightly thickened downward, hollow, silky, pallid becoming red-

dish-brown, 4–7 cm. long, 2–4 mm. thick.

TYPE LOCALITY: Northern Europe.

HABITAT: In marshes and wet places; often among sphagnum.

DISTRIBUTION: New York; also in Europe.

A sheet of specimens bearing this name is at Albany, collected by Peck at Karner in October. Another sheet with somewhat smaller plants collected by Peck in sphagnum at Karner (Center) is the basis of Peck's *Psilocybe fuscofulva*.

32. **Psilocybe castaneicolor** sp. nov.

Pileus campanulate, not fully expanding, gregarious, 2–4 cm. broad; surface glabrous, hygrophanous, bright-chestnut when fresh and moist, ochraceous when dry, the margin even or faintly striate with age; context brownish with mild taste; lamellae adnate, crowded, plane, rosy-isabelline to purplish-brown; spores ellipsoid, rounded at one end and slightly flattened but not apiculate at the other, smooth, dark-bay under the microscope, about 14–14.5 x 9 μ; stipe equal, glabrous, white, rigid-fragile, hollow, 10–18 cm. long, 4–5 mm. thick.

TYPE LOCALITY: West Park, New York.

HABITAT: On decayed sticks in wet woods.

DISTRIBUTION: Known only from the type locality.

Type collected on August 8, 1903, by F. S. Earle (*1806*), who made notes from the fresh specimens and assigned the plant to *Psilocybe*. The margin of even the youngest plants among the dried specimens is perfectly straight, as in the genus *Atylospora*.

33. PSILOCYBE LARGA Kauffm. Agar. Mich. 279. 1918

Pileus fragile, ovoid-campanulate at first, at length expanded to plane, and radiately cracked or split on the margin, gregarious or cespitose, 4–14 cm. broad; surface hygrophanous, bay-brown to ochraceous-brown and even when moist, whitish-tan and radiately rugulose when dry, at first dotted with scattered, small, snow-white, floccose, superficial scales, and quickly denuded, often only with a white-silky margin; context rather thin, white when dry, scissile, homogeneous, with large cells, with no odor or taste; lamellae adnate, rounded behind, rather broad, crowded to sub-distant, white at first, then pale-fuscous, finally umber, minutely white-fimbriate on the edges; spores ellipsoid, smooth, obtuse, purplish-brown under the microscope, umber in mass, 8–9.5 x 4–5 μ; cystidia abundant on the sides and edges of gills, subventricose

to subcylindric, narrow-stalked, obtusely rounded above, 70–80 x 12–15 μ; stipe stout, equal or tapering upward, soon hollow, terete or compressed, rather firm, usually striate to sulcate, furfuraceous but glabrescent, then shining, white, cortex subcartilaginous, 5–10 cm. long, 5–15 mm. thick.

TYPE LOCALITY: Ann Arbor, Michigan.

HABITAT: About stumps in grassy clearings or woods.

DISTRIBUTION: Vicinity of Ann Arbor, Michigan.

ILLUSTRATION: Kauffm. Agar. Mich. *pl.* 57.

Kauffman found this large and striking species not infrequent in elm swamps or clearings from May to September, but especially in the spring. The stipe seems very thick for this genus, but it is described as subcartilaginous. Specimens were kindly sent me by Dr. Kauffman some time after these studies were completed.

34. **Psilocybe caerulescens** sp. nov.

Pileus convex, slightly umbonate, gregarious or cespitose, 5–7 cm. broad; surface glabrous, slightly viscid when wet, becoming radially striate on the margin, light-dirty-yellowish-brown with a metallic luster suggesting some alloy of brass, darker on the disk, bluish when bruised or handled; context white, tough, unchanging, continuous with the stipe, with a farinaceous odor when cut, and no characteristic taste; lamellae sinuate-adnexed, light-yellow at first, dark-purplish-brown at maturity; spores broadly ovoid or subglobose, smooth, avellaneous with a yellowish tint under the microscope, very distinctive both in color and in shape, about 7 x 5.5 μ; stipe flexuous, equal, pruinose, hollow, concolorous, white at the apex, turning blue when cut, reaching 9 cm. in length and 1 cm. in thickness.

TYPE LOCALITY: Montgomery, Alabama.

HABITAT: In rich soil mixed with humus on the shaded bank of a small stream.

DISTRIBUTION: Known only from the type locality.

The description is drawn from specimens and notes sent me by Dr. R. P. Burke, who found fifteen hymenophores growing in an area about eight feet square. The plant is larger, with thicker stipe, than most species of the genus, but the stipe is decidedly cartilaginous.

DOUBTFUL SPECIES

Psilocybe ammophila (Dur. & Lév.) Sacc. Syll. Fung. **5**: 1050. 1887. Described from Algeria, growing in sand along the sea-

shore. I have not seen the type—only specimens from Cavara collected in Italy. Hard refers to this species, plants found in sandy soil during August and September near Columbus, Ohio, and photographed by Dr. Kellerman (see his figure 268).

Psilocybe atrobrunnea (Lasch) Gill. Champ. Fr. 586. 1878. Kauffman reports this species from Ann Arbor, Michigan, growing among sphagnum in tamarack bogs.

Psilocybe canofaciens Cooke, Grevillea **14**: 1. 1885. Described from specimens collected in decaying straw in England by W. G. Smith. Cooke's illustration of this species is very characteristic and striking. Kauffman reports it as rare in Michigan, with the same variable spore characters as observed in England by Massee.

Psilocybe cernua (Vahl) Quél. Champ. Jura Vosg. 116. 1872. Described from Denmark. Placed in the genus *Atylospora* by Fayod. Reported by Kauffman as infrequent in Michigan during the autumn months, occurring in clusters at the base of trees. Peck's specimens doubtfully so named, collected on chips at Forestburg, New York, in September, remind me of *Atylospora umbonata.*

Psilocybe clivensis (Berk. & Br.) Sacc. Syll. Fung. **5**: 1055. 1887. Described from England and reported from New York by Peck. The specimens attached to a sheet at Albany are too poor to be compared readily with other material.

Psilocybe ericaea (Pers.) Quél. Champ. Jura Vosg. 338. 1873. (*Agaricus ericaeus* Pers. Syn. Fung. 413. 1801.) Described from Europe and reported from New Richmond, Michigan, by Kauffman. I have not seen his specimens, but have several from Europe, including recent collections in Sweden by Romell.

Psilocybe graveolens Peck, Bull. N. Y. State Mus. 167: 47. 1913. Described as follows from specimens collected by Ballou in the Hackensack marshes, New Jersey. No measurements are given by Peck and I have not seen the specimens.

Pileus hemispheric to convex, cespitose; surface glabrous, varying in color from creamy-white to subalutaceous; context pallid, with a strong, persistent odor; lamellae crowded, subventricose, rounded behind, adnexed, brown when mature; spores subellipsoid, 8–10 × 5–6 μ; stipe equal, silky-fibrillose, stuffed or hollow, white.

Psilocybe murcida (Fries) P. Karst. Bidr. Finl. Nat. Folk **32**: 507. 1879. (*Agaricus murcidus* Fries, Syst. Myc. **1**: 299. 1821.) Described from specimens collected by Fries under beech trees in Sweden. Reported from Michigan by Kauffman as occurring in moist woods during May, June, and September. I have not seen his specimens.

Psilocybe pulicosa (Mont.) Sacc. Syll. Fung. **5**: 1056. 1887. (*Agaricus pulicosus* Mont. Syll. Crypt. 124. 1856.) Described from specimens collected on the ground at Columbus, Ohio, by Sullivant. Type not seen.

Psilocybe rhodophaea (Mont.) Sacc. Syll. Fung. **5**: 1050. 1887. (*Agaricus rhodophaeus* Mont. Syll. Crypt. 124. 1856.) Described from specimens collected among fallen leaves at Columbus, Ohio, by Sullivant. Type not seen.

Psilocybe semilanceata (Fries) Quél. Champ. Jura Vosg. 338. 1873. (*Agaricus semilanceatus* Fries, Obs. Myc. **2**: 178. 1818.) Described from Europe, occurring on manured, grassy ground. Peck's specimens from Bethlehem doubtfully so named do not at all agree with excellent material from Bresadola, Romell, and others.

Psilocybe subericaea (Fries) Sacc. Syll. Fung. **5**: 1045. 1887. Described from Sweden. There are several good collections from Alabama in the Garden herbarium and one at Albany bearing this name, but unfortunately they are not accompanied by notes. Although agreeing in a general way with the European species, I doubt if they are the same. The study of fresh plants will decide. I find the spores of the Alabama plants to be ellipsoid, smooth, pale-fulvous with a slight purplish tint under the microscope, purplish-brown in mass, about 14 x 9 μ.

Psilocybe Sullivantii (Mont.) Sacc. Syll. Fung. **5**: 1047. 1887. (*Agaricus Sullivantii* Mont. Syll. Crypt. 123. 1856.) Described from specimens collected on naked ground near Columbus, Ohio, by Sullivant. Said to be a very beautiful plant with pileus 11–12 cm. broad and stipe 10 cm. long. Type not seen.

NEW YORK BOTANICAL GARDEN.

MONOGRAPH OF THE NITSCHKIEAE[1]

Harry Morton Fitzpatrick

(With Plates 1–7)

The subfamily name, Nitschkieae, is here first applied, the group as delimited embracing the genus *Nitschkia* Otth and several other genera which agree with it in the possession among other things of turbinate perithecia collapsing at maturity to cupulate. Although the forms are characteristic, the unity of the group has not been recognized heretofore, the various genera having been placed in rather widely separated positions in the classification. In the present paper a monographic treatment of the world's species of the group is presented.

The investigation was begun several years ago, but the difficulty of obtaining material for examination has considerably delayed publication. Relatively few of the species occur in temperate North America, the paper being based largely on collections of foreign material available in the larger herbaria of the eastern United States. In the winter of 1920–1921 the writer spent a semester in the cryptogamic laboratories at Harvard University, and gave much of the time available for research to the study of this group. He has subsequently studied for briefer periods also at the same institution and in the herbaria of the New York Botanical Garden, Brooklyn Botanic Garden, Missouri Botanical Garden, Philadelphia Academy of Science, Bureau of Plant Industry, and New York State Museum. The type collections of Curtis, Schweinitz, Ellis, Peck, and others, as well as a large number of sets of exsiccati specimens, have thus been made available. The writer desires to express here his appreciation of the many courtesies shown to him by the curators of the various herbaria. He is especially indebted to Professor Roland Thaxter, who not only

[1] The investigation upon which this article is based was in part supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University.

gave him access to the exceptionally rich collections at Harvard, but also placed at his disposal a number of unidentified specimens collected in Florida and Trinidad. Material of two species collected in Porto Rico was received from Mr. C. E. Chardon, and a single specimen collected in New Zealand by Professor G. H. Cunningham was obtained from Doctor F. J. Seaver. The type collections of various comparatively unknown species have been obtained for study through the kindly coöperation of a number of individuals. The writer is especially indebted to Professors Mattirola, Patouillard, and Spegazzini for making available specimens in their herbaria.

Realizing that in the preparation of a monograph the examination of the original collection of material of every species is desirable, an effort has been made to see these in all cases. The majority have been obtained for study, but a few are wholly unavailable. Since the species which have not been seen are known only from the type collections, and were inadequately described without figures, it has been necessary to list them as doubtful. It is hoped that the appearance of this paper will stimulate mycologists who live near the type localities to search for these species and distribute material of them. Other species also, known only from a few specimens, should be more widely collected in order that some idea of geographical distribution and a clearer conception of variation in taxonomic characters may be obtained. It is realized that the study of additional material of species now known only from one or two collections may alter somewhat our concept of specific limits.

The new subfamily, Nitschkieae, has been erected tentatively in the face of a puzzling taxonomic situation. As stated above, the genera included have been treated previously in widely separated positions in the classification. In the arrangement of the Sphaeriales in Engler and Prantl's Die Natürliche Pflanzenfamilien Lindau includes *Nitschkia* in the Cucurbitariaceae, *Winteria* (cf. *Calyculosphaeria*) in the Amphisphaeriaceae, and *Thaxteria* in the Sphaeriaceae. Likewise in the Saccardo system of classification based on spore characters a wide separation of the genera here included results.

According to Lindau the family Cucurbitariaceae is characterized by the possession of a definite stroma on which the perithecia are seated, and differs in this respect from the Sphaeriaceae in which a stroma is absent. In *Cucurbitaria berberidis,* type species of the Cucurbitariaceae, the perithecia are borne in a cespitose cluster on a pseudoparenchymatous stroma, and are erumpent through the bark of the host. In *Nitschkia Fuckelii* the same situation exists, but in *Nitschkia cupularis* a stroma is wholly absent, the perithecia arising from a hyphoid subiculum which may cover a wide area on the substratum. In fact, in the Nitschkieae as here constituted relatively few species are stromatic. Moreover, in *Calyculosphaeria* indication is given of the transition from a definite stroma to a hyphoid subiculum within a single species. It is not possible, therefore, to maintain the separation between the Sphaeriaceae and Cucurbitariaceae as adopted by Lindau without placing in widely separated groups species which evidently should fall within the limits of a single genus. That the forms embraced here in the Nitschkieae constitute a natural group is indicated by their distinctive external aspect. The turbinate shape of the perithecium and its collapse to cupulate afford points of similarity. The ascigerous cavity and the tapering sterile base of the perithecium as seen in longitudinal section have the same appearance in all species whether they are stromatic or not. Other characters, macroscopic and microscopic, are correlated with these.

Since it is not possible to incorporate the Nitschkieae in any family of the Lindau classification, the inclusion of this new subfamily in its proper place in the taxonomic scheme must await an extensive revision of the Sphaeriales based on a more critical study of other subdivisions of the order. A merging of the Sphaeriaceae and Cucurbitariaceae might be accepted as a temporary solution of the difficulty. Although relatives of the Nitschkieae can not be indicated with certainty, the genus *Fracchiaea* is apparently not widely separated from the group. It differs chiefly in that the perithecia do not become cupulate at maturity. Probably a critical study of the genus will show it to lie in an intermediate position between the Nitschkieae and the genera included by Lindau in the Cucurbitariaceae. The well-known species, *F. callista,* in which

the perithecia are cupulate is wholly unlike *F. subcongregata*, type of the genus, and must be excluded from the genus. Its affinities are clearly with the Coronophoraceae, a widely separated group.

SYSTEMATIC ACCOUNT

NITSCHKIEAE subfam. nov.

Perithecium coriaceous-membranaceous to coriaceous-carbonaceous, black to brownish black, turbinate, collapsing apically to cupulate or rarely laterally shrunken, ostiolate, the terminal broadened portion enclosing a subspheric ascigerous cavity, the basal tapering portion solid and pseudoparenchymatous, seated on a hyphoid subiculum of coarse, brownish-black, multiseptate hyphae characterized by a striking metallic iridescence, or more rarely borne on a definite black, pseudoparenchymatous stroma; vegetative hyphae intramatrical, resembling the threads of the subiculum, and like them abundantly provided with thick septa; asci clavate to subcylindric, evanescent, tapering below into a long thread-like stalk, aparaphysate; saprophytic fungi occurring on decaying bark and wood.

KEY TO GENERA

A. Perithecia lacking spines.
- 1. Ascospores hyaline.
  - *a.* Ascospores allantoid, unicellular. — 1. *Nitschkia.*
  - *b.* Ascospores straight, more or less fusiform, uniseptate. — 2. *Calyculosphaeria.*
- 2. Ascospores colored.
  - *a.* Ascospores unicellular. — 3. *Tympanopsis.*
  - *b.* Ascospores 3-septate. — 4. *Thaxteria.*

B. Perithecia armed with heavy spines. — 5. *Acanthonitschkea.*

1. NITSCHKIA Otth, in Fuckel, Symb. Myc. 165. 1869. (Spelled *Nitschkea* by Saccardo.)

?*Cyathisphaeria* Dumort. Comment. Bot. 87. 1822.

Coelosphaeria Sacc. Atti Soc. Veneto-Trentina Sci. Nat. **2**: 163. 1873; Syll. Fung. **1**: 91. 1882.

Nitschkia Otth, *emend.* E. & E. N. Am. Pyren. 245, *pro parte.* 1892; Sacc. Syll. Fung. **11**: 272, *pro parte.* 1895.

Type species, *Nitschkia Fuckelii* Nitschke.

Perithecia black, coriaceous-carbonaceous, turbinate, collapsing to cupulate, scattered to cespitose, seated on a well-developed pseudoparenchymatous stroma or arising from a hyphoid subicu-

lum of coarse, brownish-black, iridescent hyphae, erumpent or superficial, characteristically tuberculate, apically ostiolate; ostiolum obscure to papilliform; asci thin-walled, evanescent, 8-spored, clavate, tapering to a long thread-like stalk, in some species apically thickened; ascospores curved, more or less allantoid, subbiseriate to crowded, hyaline, continuous, at maturity sometimes centrally and delicately pseudoseptate.

Fuckel (27) published the generic name *Nitschkia* Otth, unaccompanied by a generic description, in Symbolae Mycologicae. He describes three species: *N. Fuckelii* Nitschke *in litt.*, *N. tristis* (Pers.) Fuckel, and *N. exilis* (Alb. & Schw.) Fuckel. He states that the first is based on *Sphaeria cupularis* Fries, the second on *S. tristis* Pers., and the third on *S. exilis* Alb. & Schw. In the absence of a generic diagnosis the first-named species, *N. Fuckelii*, must be accepted as the type of the genus. In it the spores are unicellular and curved as figured by Fuckel. In the second species, *N. tristis*, the spores are straight and 1-septate. Von Höhnel (36) noted this fact and transferred the species from *Nitschkia* to *Winterina*. The third species, *N. exilis*, has perithecia wholly unlike those of *Nitschkia*, and has been transferred to the genus *Niesslia*.

The binomial *Sphaeria cupularis* was first used by Persoon (53, 55). He regarded his species as identical with the earlier described *S. cucurbitula* var. *nigrescens* Tode (85). Fries (24, 25) uses the Persoon name, and cites *S. Pruni* Schum. (72) as synonymous. Moreover, he distributed exsiccati specimens[2] illustrating the species. Since authentic material from the herbaria of Tode, Persoon, and Schumacher is not available, and since the descriptions and figures given by these older writers are in no case adequate for a certain identification, it seems best to base our conception of the species on the material of Fries, a portion of which has been available for study.

Although Fuckel (27) states that *Nitschkia Fuckelii* Nitschke is based on *Sphaeria cupularis* Fries, a comparison of the material distributed by him in Fungi Rhenani with that distributed by Fries proves that two fungi are represented. They are included here as *N. Fuckelii* and *N. cupularis* respectively. The first differs from

[2] Fries, Scler. Suec. Exsic. 231.

the second in having a definite pseudoparenchymatous stroma and smaller perithecia. In *N. cupularis* a hyphoid subiculum is developed.

The genus *Cyathisphaeria* was founded by Dumortier (16) in Commentationes Botanicae. He gives a brief and inaccurate generic diagnosis, "*Sphaerulae aggregatae, astomeae, stromate insertae,*" followed by an enumeration of six species, the first named being *C. cupularis,* based on *Sphaeria cupularis* Pers. Since *S. berberidis* and several other unrelated species are included the genus has no value. Moreover, it is impossible to use the name *Cyathisphaeria* to replace *Nitschkia* on account of uncertainty as to the identity of *S. cupularis* Pers.

Saccardo (65) published *Coelosphaeria* in 1873 to replace *Nitschkia* Otth because of the existence in the diatoms of the older name, *Nitzschia* Hassall 1845, of similar sound. Although as originally published the name *Coelosphaeria* was unaccompanied by a generic description, Saccardo (64) later provided it with one, and included in the genus several species in addition to those incorporated in *Nitschkia* by Fuckel. As the type of the genus he cites the type species of *Nitschkia, N. Fuckelii.* Incidentally he changes the original spelling of *Nitschkia* to *Nitschkea,* the genus having been named for Nitschke.

Ellis (20) limited the genus *Nitschkia* to include only those species in which the perithecia are cespitose, and recognized the genus *Coelosphaeria* for those in which they are scattered. Saccardo (64) accepted this separation, and it has been employed by Berlese (5) and others.

From the standpoint of present-day procedure in nomenclature *Coelosphaeria* has no standing whatever and must be abandoned. Saccardo was not justified in replacing *Nitschkia* Otth with *Coelosphaeria,* as *Nitschkia* is hardly to be regarded as a homonym of *Nitzschia.* Moreover, Ellis in applying the name *Nitschkia* in connection with its original type deprives *Coelosphaeria* of its monotype. The genus *Coelosphaeria* as emended by Ellis includes four species, no one of which is sufficiently close in its relationships to *Nitschkia* to fall within the scope of the present monograph.

Although the original publication of the name *Nitschkia* Otth

was unaccompanied by a generic description, the three species included were adequately described, and figures and herbarium specimens were cited in each case. Since there is no uncertainty as to the identity of the type species, the retention of the generic name seems desirable. In the selection of lists of *genera conservanda* for the fungi it is recommended that *Nitschkia* Otth be included.

Thirty-two species have been described either as *Nitschkia* or *Coelosphaeria*. In the present revision only three of these are included in *Nitschkia*, a single new species being described. Of the remaining twenty-nine species, nine have been transferred to the related genera *Calyculosphaeria, Tympanopsis,* and *Thaxteria,* thirteen are definitely excluded from the Nitschkieae, and seven remain as doubtful due to the inadequacy of the original descriptions and the lack of authentic material for examination. The following list indicates the status of each species. In those cases in which a species has been included in the past both in *Nitschkia* and *Coelosphaeria* it is here listed as originally described. Further information concerning the doubtful and excluded species is given at the end of the treatment of *Nitschkia.*

C. acervata Karst. .... excluded
C. anceps Sacc. & Malbr. .... doubtful
N. Beccariana (Berl. & Pegl.) Kuntze .... *Tympanopsis*
N. bambusarum Rehm .... excluded
C. calyculus (Mont.) Sacc. .... *Calyculosphaeria*
C. chiliopyxis (B. & C.) Sacc. .... excluded
N. collapsa (Romell) Chentantais .... *Calyculosphaeria*
C. corticata E. & E. .... excluded
C. crustacea Karst. .... doubtful
N. cupularis Karst. .... *Nitschkia*
N. euomphala (B. & C.) E. & E. .... *Tympanopsis*
N. exilis (Alb. & Schw.) Fuckel .... excluded
N. Flageoletiana Sacc. .... excluded
N. Fuckelii Nitschke .... *Nitschkia*
C. fusariospora E. & E. .... excluded
C. Granati H. Fabre .... doubtful
N. javanica Henn. & Nym. .... *Nitschkia*
C. leptosporoides Wint. .... *Thaxteria*
C. media Sacc. .... doubtful
N. moravica Niessl .... doubtful

N. pauridia B. & C. ....excluded
N. pezizoidea (Pat. & Gaill.) Kuntze ....*Calyculosphaeria*
C. pusillima Speg. ....excluded
N. radicalis (Cooke) Kuntze ....excluded
C. recedens (Niessl) Berl. ....excluded
C. roseospora Pat. ....excluded
N. rugulosa (Rick.) v. Höhn. ....*Thaxteria*
N. subconica Feltg. ....doubtful
N. subconnata (B. & C.) Kuntze ....excluded
C. suberis Wint. ....doubtful
N. tristis (Pers.) Fuckel ....*Calyculosphaeria*
N. Winteriana Sacc. ....*Calyculosphaeria*

In the following key the species are separated into two groups. In the first, typified by *N. Fuckelii,* the perithecia are borne on a pseudoparenchymatous stroma; in the second, typified by *N. cupularis,* they are seated on a hyphoid subiculum. Since the perithecia in the stromatic forms are typically cespitose, the separation recalls that of Ellis for *Nitschkia* and *Coelosphaeria.* However, in the light of the relative meagerness of our knowledge of the group, and considering the small number of species included, there is no justification for splitting the genus on the basis of the presence or absence of stromatic tissue. Von Höhnel (35) and Chentantais (11) have both emphasized this fact.

KEY TO THE SPECIES OF NITSCHKIA

A. Perithecia borne on a pseudoparenchymatous stroma, densely gregarious to cespitose.
  1. Perithecia small, 200–270 μ in diameter; ascospores 9–11 × 2 μ. 1. *N. Fuckelii* (Figs. 3, 20, 36).
  2. Perithecia large, reaching 600 μ in diameter. ascospores 15–20 × 3–3.5 μ. 2. *N. floridana* (Figs. 4, 18, 37).

B. Perithecia seated on a hyphoid subiculum, scattered to densely gregarious.
  1. Ascospores 9–16 × 2 μ. 3. *N. cupularis* (Figs. 1, 2, 19).
  2. Ascospores 18–22 × 9–12 μ 4. *N. javanica.*

1. NITSCHKIA FUCKELII Nitschke, in Fuckel, Symb. Myc. 165. 1869

Coelosphaeria Fuckelii Sacc. Atti Soc. Veneto-Trentina Sci. Nat. 2: 163. 1873.

Winteria tuberculifera var. *caespitosa* E. & E. N. Am. Pyren. 212. 1892.

ILLUSTRATIONS: Fuckel, Symb. Myc. *pl. 3, fig. 1.* Berl. Ic. Fung. 3: *pl. 30.*

(Figures 3, 20, 36)

Perithecia erumpent through crevices in the bark, cespitose, forming pulvinate, hemispheric or elongated groups, 0.5–5.0 mm. in diameter, containing several dozen individuals, borne on a well-developed pseudoparenchymatous stroma, black, glabrous, tuberculate, turbinate, the apex provided with a papilliform ostiolum evident both before and after collapse, 200–270 μ in diameter, frequently irregular from lateral pressure; asci clavate, 8-spored, thin-walled, chiefly 25–35 x 10 μ (p. sp.), tapering to a thread-like base; spores allantoid, subbiseriate to crowded, hyaline, provided at each end with a single, small, bright, refractive globule, 9–11 x 2 μ.

Differing from *N. cupularis* chiefly in the possession of a definite pseudoparenchymatous stroma, and in its smaller perithecia and somewhat shorter spores.

MATERIAL EXAMINED

Fuckel, Fungi Rhen. Exsic. *968* (at Harvard Univ.).

Berk. Brit. Fungi *174* (at Harvard Univ. and Missouri Bot. Gard.).

Karst. Fungi Fenn. Exsic. *861* (at Harvard Univ.).

Sydow, Myc. Mar. *1915, 2430, 4131* (at N. Y. Bot. Gard. and Harvard Univ.).

Roum. Fungi Gall. Exsic. *1488* (at Cornell Univ. and Harvard Univ.).

Thüm. Myc. Univ. *1947* (at N. Y. Bot. Gard., Harvard Univ., and Bur. Pl. Ind.).

Moug. & Nestl. Stirp. Crypt. Vogeso-Rhen. *771* (at N. Y. Bot. Gard.).

Herb. Barbey-Boiss. *591, ex Herb.* Fuckel (at Harvard Univ.).

Ellis Herb. *1535, 1777b,* labelled *Winteria tuberculifera* var. *caespitosa* (at N. Y. Bot. Gard.).

2. **Nitschkia floridana** sp. nov.

TYPE: In Herb. R. Thaxter at Harvard Univ. (portion of type collection deposited as *1894* in Herb. Fitzpatrick).

(Figures 4, 18, 37)

Perithecia 350–600 μ in diameter, coarsely roughened with large, irregular warts, black, shiny, densely gregarious to cespitose, frequently irregular in shape from crowding, completely collapsing apically but due to the extreme roughness of the wall failing to assume a definite cupulate aspect, seated on a prominent, pseudoparenchymatous stroma, superficial on decorticated wood, not erumpent; subiculum lacking; ostiolum obscure; asci clavate, long-stipitate, thin-walled, evanescent, 35–60 x 9 μ (*p. sp.*), 8-spored, not apically thickened; spores typically allantoid, occasionally straight, subbiseriate to crowded, hyaline, continuous, in age developing a central pseudoseptum, 15–20 x 3–3.5 μ, prominently guttulate.

On decorticated wood in Florida.

MATERIAL EXAMINED

Herb. R. Thaxter at Harvard University, *type,* collected by R. Thaxter at Daytona, Florida, January 1898 (portion of type collection deposited as *1894* in Herb. Fitzpatrick); another collection made by R. Thaxter at Cocoanut Grove, Florida, October 1897 (portion deposited as *1896* in Herb. Fitzpatrick).

3. NITSCHKIA CUPULARIS Karst. Myc. Fenn. **2**: 81. 1873

? *Sphaeria cucurbitula* var. *nigrescens* Tode, Fungi Meckl. **2**: 39. 1791.

? *Sphaeria cupularis* Pers. Obs. Myc. 65. 1796; Syn. Fung. 53. 1801.

? *Sphaeria Pruni* Schum. Enum. Pl. Saell. **2**: 164, 165. 1803.

Sphaeria cupularis Fries, Sv. Vet.-Akad. Handl. **37**: 112. 1817; Syst. Mycol. **2**: 416. 1823.

Cucurbitaria cupularis Gray, Nat. Arr. Brit. Pl. **1**: 519. 1821.

Cyathisphaeria cupularis Dumort. Comment. Bot. 87. 1822.

Hypoxylon cupulare Kickx, Fl. Crypt. Louvain 114. 1835.

Cucurbitaria cupularis Cooke, Handb. Brit. Fungi ed. 2: 842. 1871.

Coelosphaeria cupularis Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 42. 1879.

ILLUSTRATIONS: Berl. Ic. Fung. **3**: *pl. 29* under *Nitschkia tristis* is apparently this species.

(Figures 1, 2, 19)

Perithecia erumpent through crevices in the bark, occasionally more or less superficial, gregarious, black, minutely roughened, not definitely tuberculate, turbinate, 300–450 μ in diameter, the flattened apex provided with a prominent, central, papilliform ostiolum, the base supplied with a tuft of prominent, coarse, brown hairs, 6–7 μ in diameter, which radiate over the substratum and mingle with others from neighboring individuals forming a definite, hyphoid subiculum; no evidence of stromatic tissue; collapse first indicated by a circular depression around the papilla, finally complete, the perithecium becoming deeply cupulate with the papilla evident in the bottom of the cup; asci clavate, 8-spored, 22–40 x 8–12 μ (*p. sp.*), thin-walled except at the apex where a peculiar hyaline thickening is developed, tapering to a thread-like base, evanescent; spores curved, subbiseriate to crowded, hyaline, often provided with terminal guttulae as in *N. Fuckelii,* continuous, in age multiguttulate and pseudoseptate, 9–16 x 2 μ.

Nitschkia cupularis as treated in the literature is a composite species, including the species segregated above as *N. Fuckelii.* As here treated it is based on the material distributed by Fries to illustrate "*Sphaeria cupularis* Pers. ex Fries." Since doubt exists as to its identity with *S. cupularis* Pers., the synonymy given above is of doubtful value. The species has been generally misunderstood. Von Höhnel (36) points out that a number of exsiccati specimens purporting to represent it are merely aged collections of *Gibberella pulicaris,* and the writer has on several occasions found that material labelled *Nitschkia cupularis* was in reality old and blackened *Nectria cinnabarina.* This confusion in exsiccati combined with the fact that two or more species have been included under the one name has made a clear understanding of the species difficult to obtain.

MATERIAL EXAMINED

Fries, Scleromyc. Suec. *231* (at Harvard Univ.).
Plowr. Sphaer. Brit. *63* (at Harvard Univ.).
Rehm, Ascom. *1743* (at Harvard Univ. and in Bur. Pl. Ind.).

4. NITSCHKIA JAVANICA Henn. & Nym. Monsunia **1**: 167. 1900

Thaxteria javanica v. Höhn. Ann. Myc. **16**: 75. 1918.

TYPE: In Herb. Hennings (a slide in Herb. Fitzpatrick made

from single perithecium shows hyphae of subiculum, but not asci or spores).

Perithecia scattered to cespitose, borne on a subiculum of brown hyphae, 3–4 μ in diameter, turbinate with a papilliform ostiolum, radiately substriate to subrugose, approx. 1 mm. in diameter; asci clavate, obtuse, base attenuated, 100–120 x 10–12 μ; spores obliquely uniseriate, oblong-subcylindric, subcurved, 2–3-guttulate, 18–22 x 9–12 μ.

Java, on decaying branches, July 1898, E. Nyman.

A portion of the type material was received in a much crumbled condition, and only a single perithecium was obtained for study. It was used in the preparation of a microscopic mount, but yielded no asci or spores. It was cupulate, having been turbinate before the collapse, and was attached to the brown hairs of the subiculum. The above description is based on the original diagnosis. Von Höhnel (36) states that the species should be transferred from *Nitschkia* to *Thaxteria,* but does not say that he has studied material of it. Although our knowledge of the species is very incomplete, there seems to be justification for retaining it in the genus *Nitschkia.*

DOUBTFUL SPECIES OF NITSCHKIA

The following seven species, placed by their authors in *Nitschkia* or *Coelosphaeria,* may for the present be listed as doubtful members of the genus *Nitschkia.* They are known only from the type collections, and the writer's efforts to obtain material for study have been unsuccessful. The original descriptions are in every case inadequate and unaccompanied by illustrations.

1. COELOSPHAERIA ANCEPS Sacc. & Malbr. Atti Ist. Veneto VI. 1: 1273. 1882

Nitschkia anceps Berl. Ic. Fung. 3: 23, 24. *pl. 31.* 1900.

The type collection of this species is represented by a fragmentary specimen in the herbarium of Saccardo. It has not been available to the writer, but Berlese (5) states that his figures are drawn from it. A translation of the original description follows:

"*Perithecia erumpent-superficial, in minute subcircular groups 1 mm. in diam., densely crowded, globose, becoming cupulate,*

black, 1/5–1/6 mm. in diam.; ostiolum obscure; context pseudoparenchymatous, black; asci clavate, tapering below, 60–63 x 8–10 μ, surrounded by broad septate paraphyses, 8-spored; ascospores biseriate, allantoid, straight to curved, 10–14 x 3 μ, bi- to quadriguttulate, hyaline."

2. COELOSPHAERIA CRUSTACEA Karst. Acta Soc. Faun. Fl. Fenn. 27: 7. 1905

Nitschkia crustacea Sacc. & Trott. Syll. Fung. 22: 68. 1913.

A translation of the original inadequate description follows: "*Perithecia very much crowded, beautifully cupulate, black, naked, very minute; asci cylindric-clavate, 8-spored; spores subbiseriate, elongated, curved to straight, hyaline, 8–12 x 2 μ.*"

A specimen collected by J. F. Brenckle (9) at Wirch Lake, Kulm, North Dakota, and distributed by him[3] was examined by Rehm and identified as questionably this species. This material has been examined by the writer, and although it can not be said to differ in any respect from the description given by Karsten, it is certainly not a *Nitschkia.*

3. COELOSPHAERIA GRANATI H. Fabre, Ann. Sci. Nat. VI. 15: 31–69. 1883

Nitschkia Granati Kuntze, Rev. Gen. 3^2: 501. 1898.

The original description translated follows: "*Perithecia buried in the bark, erumpent, scattered to cespitose, 1/3 mm. in diam., globose, apically flattened to somewhat cupulate; ostiolum papillate, occasionally rostrate; asci cylindric-clavate, sessile, 8-spored, 40–50 x 6–7 μ; ascospores subbiseriate, cylindric, curved, hyaline, provided at each end with a refractive guttule, 10 x 2 μ.*"

4. COELOSPHAERIA MEDIA Sacc. Michelia 2: 592. 1882

This species is figured by Berlese (5) from the original specimen, but the figure can not be said to demonstrate that the fungus is in reality a *Nitschkia.* A portion of the type collection was sent to the writer from the herbarium of Saccardo, but failed to show perithecia of *Nitschkia.* Von Höhnel (36) regards the

[3] Brenckle, N. D. Fungi 700.

species as perhaps a member of the genus *Loranthomyces.* The original description translated is as follows: "*Perithecia cespitose, erumpent, globose to depressed, then umbilicate, 1/3 mm. diam., rugulose-shaggy, black; asci clavate, short stalked, 20 x 6–7 μ (p. sp.), 8-spored; spores biseriate, allantoid, 8–9 x 1.5–2 μ, quadriguttulate, hyaline.*"

5. NITSCHKIA MORAVICA Niessl in Paul, Verh. Natürforsch. Ver. Brunn **47**: 139, 140. 1908

A translation of the original description follows: "*Perithecia aggregated, often densely cespitose, 0.2 mm. in diam., subovoid, collapsing to cupulate, nearly black, fibrous at the base; asci clavate, long stipitate, 50–70 μ (p. sp. 40) long, 12 μ wide, 8-spored; spores 1–3-seriate, cylindric, curved, hyaline, ends obtuse and each provided with one oil globule, 10–11 x 2–3 μ.*"

6. NITSCHKIA SUBCONICA Feltg. Rec. Mém. Soc. Bot. Luxemb. **15**: 201. 1902

From the original description this species seems not to be one of the Nitschkieae, but since material has not been examined it can not yet be definitely excluded from the group.

7. COELOSPHAERIA SUBERIS Wint. Bol. Soc. Brot. **1883**: 17. 1884

Lasiosphaeria suberis Cooke, Grevillea **15**: 122. 1887.
Nitschkia suberis v. Höhn. Ann. Myc. **16**: 105. 1918.

The original description translated follows: "*Perithecia scattered to gregarious, superficial, lacking a subiculum, lenticular, finally collapsed to concave, black, rugulose and very sparingly covered with very short, brown, septate hairs. Asci cylindric, tapering somewhat at both ends, sessile, 8-spored, 80–90 x 10 μ, surrounded by filiform paraphyses; ascospores irregularly biseriate, allantoid, almost semicircular, hyaline, continuous, 17–23 x 3–5 μ.*"

EXCLUDED SPECIES

The following thirteen species placed by their authors in *Nitschkia* or *Coelosphaeria* are here excluded from the Nitschkieae. Authentic material has been examined in practically every case.

The fungi lack the essential characters of *Nitschkia* and its relatives. Nine additional species have been transferred to *Calyculosphaeria, Tympanopsis,* and *Thaxteria.*

1. COELOSPHAERIA ACERVATA Karst. Medd. Soc. Faun. Fl. Fenn. 5: 55. 1879

Nectri Coryli Fuckel, Symb. Myc. 180. 1869.

In the original description of this species Karsten (39) states that the perithecia are red. Moreover, in a later paper (40) he cites his binomial as a synonym of *Nectria Coryli* Fuckel. Berlese (5) points out that the appendiculate spores place the species in *Aponectria.*

2. NITSCHKIA BAMBUSARUM Rehm, Leaf. Philippine Bot. 8: 2956. 1916

Material identified by Rehm[4] has been examined and found to lack the essential characters of the Nitschkieae. The perithecia are spheric, possess a prominent beak, and do not become cupulate. The spores, though allantoid, are in mass distinctly yellowish. The species is of doubtful relationships.

3. COELOSPHAERIA CHILIOPYXIS (B. & C.) Sacc. Syll. Fung. 1: 95. 1882

Sphaeria chiliopyxis B. & C. Grevillea 4: 141. 1876.
Nitschkia chiliopyxis Kuntze, Rev. Gen. 3^2: 501. 1898.

The material on which this species was erected was collected by Ravenel at Aiken, South Carolina. The writer has seen a portion of the type collection in the herbarium of Curtis as well as several co-type specimens. In none of these have asci or spores been found. The bodies described as perithecia are minute (85–170 μ), black, shiny, tuberculate spheres seated directly on the fibers of the wood, evident mycelium being absent. They lack an ostiolum, and there is in reality nothing to indicate that they are fruit-bodies. They resemble somewhat the bulbils of *Papulospora.* The assumption of Berlese (5) that they are the pycnidia of *Aposphaeria* is unwarranted.

[4] Baker, Fungi Malay. *168.*

4. COELOSPHAERIA CORTICATA E. & E. Proc. Acad. Phila. 1890: 221. 1890

Nitschkia corticata Kuntze, Rev. Gen. 3^2: 501. 1898.

This species was collected by C. H. Demetrio[5] on bark of dead *Maclura aurantiaca* at Emma, Missouri, November 1889, and is known only from the type collection. The writer has examined portions of this collection in the herbarium of Ellis at the New York Botanical Garden, and in the Everhart Herb. at Harvard University. The fungus is apparently an undescribed species of *Coronophorella.*

5. NITSCHKIA EXILIS (Alb. & Schw.) Fuckel, Symb. Myc. 165. 1869

Sphaeria exilis Alb. & Schw. Consp. Fung. 44. 1805.
Chaetomium pusillum Fries, Syst. Myc. 3: 255. 1829.
Venturia Chaetomium Ces. & de Not. Schema, in Comm. Soc. Crit. Ital. 1: 225. 1863.
Niesslia Chaetomium Auerswald in Gonn. & Rab. Myc. Eur. 5–6: 30. 1869.
Coelosphaeria exilis Sacc. Syll. Fung. 1: 92. 1882.
Niesslia exilis Wint. in Rab. Krypt.-Fl. 1^2: 196. 1887.

Authentic specimens of *Sphaeria exilis* Alb. & Schw. have been studied in the herbaria of Schweinitz and Curtis. The material was collected at Niesky in Lusatia. Several other specimens unquestionably of the same fungus have been seen. One of these was collected by Curtis (15) at Society Hill, South Carolina, the others are specimens distributed by Fuckel,[6] Karsten,[7] and Jaap.[8] A specimen in the herbarium of Curtis collected by Schweinitz at Nazareth, Pennsylvania, and labelled *Sphaeria exilis* Alb. & Schw. is not this species. It shows colored 3-septate spores and is *Melanomma exile* (Schw.) E. & E. Moreover, the American material in the herbarium of Schweinitz differs from the type collection from Niesky.

[5] Herb. Demetrio *272*.
[6] Fuckel, Fungi Rhen. *2023*.
[7] Karst. Fungi Fenn. Exsic. *876*.
[8] Jaap, Fungi Sel. Exsic. *187*.

Sphaeria exilis Alb. & Schw. has been found to have 2-celled spores and should probably bear the name *Niesslia exilis* (Alb. & Schw.) Wint. (90). Although included by Fuckel in the genus *Nitschkia,* it lacks the essential characters of the Nitschkieae as here treated.

6. NITSCHKIA FLAGEOLETIANA Sacc. Manipolo di Micromiceti nuovi. Rend. Congresso Bot. Palermo 48. 1902

Bertia parasitica H. Fabre, Ann. Sci. Nat. VI. **9**: 95. 1878.
Homostegia parasitica Rehm, Hedwigia **26**: 97. 1887.
Microthyrium epimyces Sacc., Bomm. & Rouss. in Bomm. & Rouss. Bull. Soc. Bot. Belg. **26**: 209. 1887; Hedwigia **26**: 97. 1887.
Myiocopron Flageoletianum v. Höhn. Sitzungsber. K. Akad. Wiss. Wien **124**: 18, 19. 1915.
Trichothyrium epimyces Theiss. Ann. Myc. **14**: 430–432. 1916.
Loranthomyces epimyces v. Höhn. Sitzungsber. K. Akad. Wiss. Wien **126**: 283–352. 1917.

This species has been variously placed by different writers. The perithecium is well figured by Chentantais (**11**), and is shown to be of the flat, shield-shaped type. Von Höhnel has referred the fungus to the genus *Loranthomyces* and Theissen and Sydow (**83**) include it in this genus in the family Trichothyriaceae. The writer has examined a number of exsiccati specimens distributed under the various names listed in the above synonymy and has found them all to be the same. The species is not as suggested by Rehm identical with *Dothidea episphaeria* Peck. Examination of the type material of this fungus shows it to be very different.

7. COELOSPHAERIA FUSARIOSPORA E. & E. Jour. Myc. 4: 62–65. 1888. (Misspelled *fusariispora* in N. Am. Fungi, *3016*.)

The type material of this species in the herbarium of Ellis has been studied. Other authentic specimens have also been examined. The ascospores at maturity are clearly 1-septate and narrow fusoidal, the perithecia are spheric, a stroma or subiculum is absent, and paraphyses are abundant. Although the perithecia collapse to cupulate, the species can not be regarded as closely related to *Nitschkia.* It is strikingly similar to *Winteria rhuina* E. & E. and

may be the same. Von Höhnel suggests that the species may be a *Leptosporella.*

8. NITSCHKIA PAURIDIA B. & C. Grevillea 20: 107. 1891

Sphaeria pauridia B. & C. in Herb.
Fracchiaea pauridia Berl. Ic. Fung. 3: 25. 1900.

The original description of *Nitschkia pauridia* B. & C. is based on Curtis's specimen *1413*. In his herbarium there is a packet of material labelled by him as follows: "*Sphaeria Meliae* ? Schw. (1413) Meliae Ram. mort. Sept. 1847, Society Hill, South Carolina." In manuscript which accompanies his specimens he cancelled the name *S. Meliae* and substituted *S. pauridia,* but he neglected to make this change on the packet. The fungus is not *S. Meliae* Schw. A portion of the type collection of the latter species deposited in the Curtis herbarium and labelled "*Sph. Meliae* Schw. No. 298" shows an entirely different sort of fungus.

The asci of *N. pauridia* B. & C. are polysporous. This fact was recognized by Curtis, for he pictures an ascus on the packet of material. It is strange that Cooke overlooked the point. Berlese figures the fungus and describes it as *Fracchiaea pauridia* (B. & C.) comb. nov. The perithecia are black, turbinate, erumpent in clusters of ten or more, and resemble in form and habit those of *F. subcongregata* (B. & C.) E. & E., type of the genus. They bear short spines as in this species and possess a noticeable papilliform ostiolum.

9. COELOSPHAERIA (?) PUSILLIMA Speg. Anal. Soc. Ci. Argent. 47: 269. 1899

A portion of the type collection of this species, kindly forwarded by Professor Spegazzini, has been examined and found to be very unlike *Nitschkia* and its relatives. The perithecium is minute (approx. 150 μ in diam.) and is provided with a prominent beak. A stroma is absent and the perithecia are scattered or occasionally loosely aggregated. There is no evidence of superficial hyphae and the perithecium does not collapse. The species would seem to belong to *Ceratostomella* rather than to *Coelosphaeria.*

10. NITSCHKIA RADICALIS (Cooke) Kuntze, Rev. Gen. 3^2: 501. 1898

Cucurbitaria radicalis Cooke, Grevillea 7: 51. 1878.
Coelosphaeria radicalis Sacc. Syll. Fung. 1: 93. 1882.

Material distributed by Ravenel[9] has been examined at Harvard, the New York Botanical Garden, and Cornell. The fruit-bodies possess a beaked ostiolum, and are flask-shaped, cespitose, and erumpent. No asci were found. Brown 2-celled oval pycnospores are present. The fruit-body is evidently a pycnidium. The fungus has been variously treated, being placed by different authors in *Dothiorella, Diplodia, Botryodiplodia,* etc. Regardless of whether the form is ascigerous or not, the fungus is clearly not closely related to *Nitschkia.*

11. NITSCHKIA RECEDENS (Niessl) Berl. Ic. Fung. 3: *22. pl. 27, fig. 2.* 1900

Calosphaeria recedens Niessl in Thüm. Contr. Fl. Myc. Lusit. 25, 26. 1881.

Von Höhnel (36) states that *Calosphaeria recedens* Niessl is from the description clearly a species of *Romellia* Berl. and not as treated by Berlese (5) a *Nitschkia.*

Authentic material distributed by de Thümen[10] has been examined by the writer and compared with authentic material of *Calosphaeria vibratilis* (Fries) Nitschke, type species of the genus *Romellia* Berl. The asci and spores in the two species are similar, several asci being borne on a branching "ascophore" as figured by Berlese. The perithecia of *C. recedens* are much smaller than those of *C. vibratilis,* and lack the peculiar flattened tip found in the latter species. No cupulate individuals have been observed in either case.

Calosphaeria recedens is not closely related to *Nitschkia.* The perithecia are small (200–250 μ), globose, crowded to scattered, buried in the inner bark and remaining covered for a long time, finally erumpent and protruding, provided with a prominent papilliform to short-beaked ostiolum and not collapsing.

[9] Rav. Fungi Am. Exsic. *344.*
[10] Thüm. Myc. Univ. *1784.*

12. COELOSPHAERIA ROSEOSPORA Pat. Tab. Fung. 7: 74. 1889

Nitschkia roseospora Kuntze, Rev. Gen. 3^2: 501. 1898.

Berlese (5) states that this species belongs to *Bizzozeria* Sacc. Von Höhnel (36) says that it is merely the young condition of *B. sorbina* (Nyl.) v. Höhn. The writer has attempted to obtain a portion of the original collection for examination, but without success. Patouillard has written that the entire specimen was sent to Berlese for use in the preparation of Icones Fungorum. It has not been possible to obtain it from the herbarium of Berlese, and no other material bearing this name has been seen. The figures given by Patouillard are, however, sufficient to show that the fungus is not closely related to *Nitschkia.* The filamentous paraphyses, the rosy spores, and the white matted mycelium show it to be very different.

13. NITSCHKIA SUBCONNATA (B. & C.) Kuntze, Rev. Gen. 3^2: 501. 1898

Sphaeria subconnata B. & C. Grevillea 4: 141. 1876.
Gibbera moricarpa Cooke, Grevillea 7: 51. 1878.
Coelosphaeria subconnata Sacc. Syll. Fung. 1: 93. 1882.
Fracchiaea subconnata Berl. Ic. Fung. 3: 24, 25. *pl. 31, fig. 2.* 1900.

Berkeley (3) in his description of *Sphaeria subconnata* B. & C. states that the asci are "stuffed with the minute sausage-shaped sporidia." Berlese (5) examined the type specimen, compared it with the original collection of *Gibbera moricarpa* Cooke, found the two to be identical, and includes the species in the genus *Fracchiaea.* His figure drawn from the type of Berkeley shows a polysporous ascus. Saccardo was clearly in error in including the species in *Coelosphaeria.*

Sphaeria subconnata Schw. (74) is an entirely different species. A portion of the type collection in the Curtis herbarium has been examined, and it agrees with the description of Schweinitz. The fruit-bodies are black, occur in elongated areas rupturing the bark by a long, narrow slit, and becoming erumpent. They are probably pycnidia. They contain small, unicellular, hyaline, oval spores. The material was collected on the stems of cotton, while the

original collection of the species of Berkeley and Curtis was made on liquidambar.

(To be concluded in the March number)

EXPLANATION OF PLATES

The drawings were made by the writer with the aid of a camera lucida, and reduced one fourth in reproduction. The magnifications given refer to the figures as reproduced. Leitz apochromatic objectives and compensating oculars were used.

PLATE 1

Fig. 1. *Nitschkia cupularis.* An ascus with mature spores. × 960.
Fig. 2. *N. cupularis.* A group of ascospores. × 960.
Fig. 3. *N. fuckelii.* A group of ascospores. × 960.
Fig. 4. *N. floridana.* A group of ascospores. × 960.
Fig. 5. *Cyathisphaeria collapsa.* A group of ascospores. × 960.
Fig. 6. *C. tristis.* An ascus. × 960.
Fig. 7. *C. pezizoidea.* A group of spores. × 960.
Fig. 8. *C. macrospora.* An ascus with mature spores. × 675.

PLATE 2

Fig. 9. *Thaxteria leptosporoides.* An ascus (×685) and several free spores (× 960). The spores in the ascus are immature, hyaline, and 1-septate. the free spores represent several stages in later development, the mature spores being brown and 3-septate.

Fig. 10. *T. didyma.* A group of spores of various degrees of maturity. × 960.

Fig. 11. *Acanthonitschkea argentinensis.* A group of ascopores. × 960.
Fig. 12. *A. argentinensis.* A perithecial spine. × 480.
Fig. 13. *A. macrobarbata.* A group of ascopores. × 960.
Fig. 14. *A. macrobarbata.* A perithecial spine. × 480.

Fig. 15. *A. macrobarbata.* A portion of a branching hypha from the subiculum. × 480.

Fig. 16. *Tympanopsis euomphala.* Two asci with mature spores. × 960.
Fig. 17. *T. uniseriata.* An ascus with mature spores. × 960.

PLATE 3

Fig. 18. *Nitschkia floridana.* Perithecia of the type specimen. × 20.
Fig. 19. *N. cupularis.* Perithecia. ×20.
Fig. 20. *N. Fuckelii.* Erumpent groups of perithecia. ×20.

Fig. 21. *Calyculosphaeria macrospora.* Perithecia of the type specimen. × 20.

PLATE 4

Fig. 22. *C. collapsa.* Perithecia. ×20.
Fig. 23. *C. collapsa.* Perithecia. × 6.
Fig. 24. *C. pezizoidea.* Perithecia of the type specimen. × 20.
Fig. 25. *C. tristis.* Perithecia. × 20.

PLATE 5

Fig. 26. *Tympanopsis uniseriata.* Perithecia from the type specimen. × 20.

Fig. 27. *T. euomphala.* Perithecia. × 20.

Fig. 28. *T. uniseriata.* Perithecia. × 6.

Fig. 29. *Acanthonitschkea macrobarbata.* Perithecia. × 6.

PLATE 6

Fig. 30. *Thaxteria leptosporoides.* Perithecia. × 6.

Fig. 31. *T. leptosporoides.* Perithecia. × 20.

Fig. 32. *T. didyma.* Perithecia from the type specimen. × 20.

Fig. 33. *T. didyma.* Perithecia from the type specimen. × 6.

PLATE 7

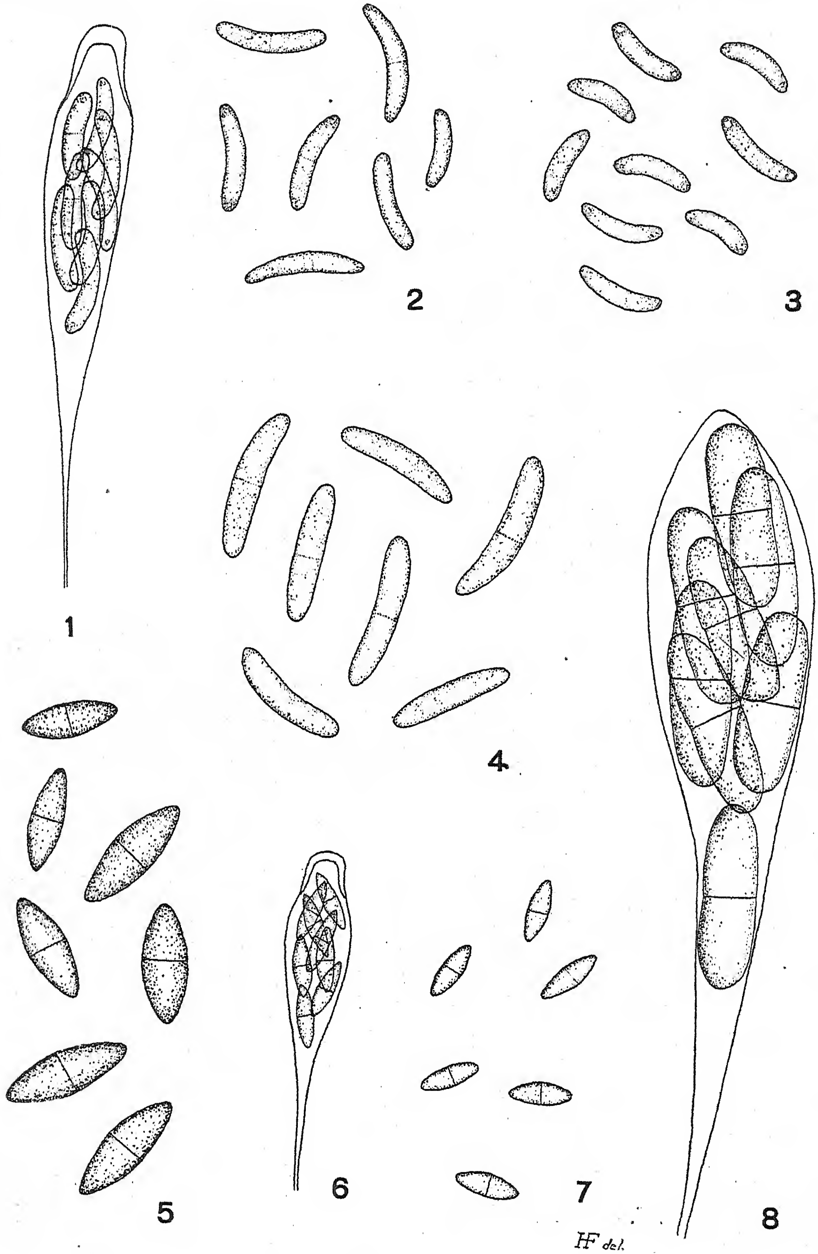
Fig. 34. *Calyculosphaeria tristis.* Perithecia in longitudinal section. × 43. The hairs of the subiculum and the bases of the perithecia were loosened from the substratum in sectioning.

Fig. 35. *Thaxteria didyma.* A perithecium in longitudinal section. × 43.

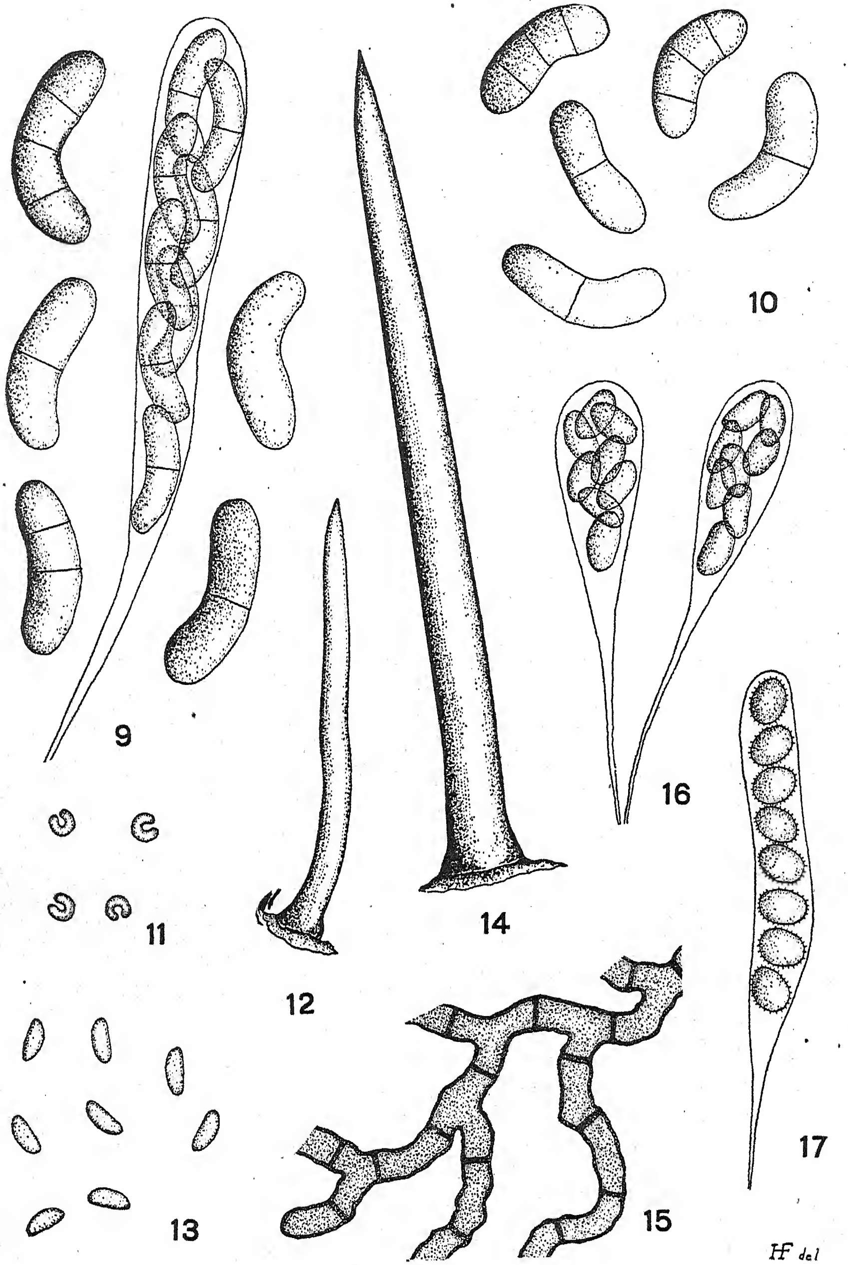
Fig. 36. *Nitschkia Fuckelii.* Perithecia and stroma in longitudinal section. × 43.

Fig. 37. *N. floridana.* Perithecia and stroma in longitudinal section. × 43.

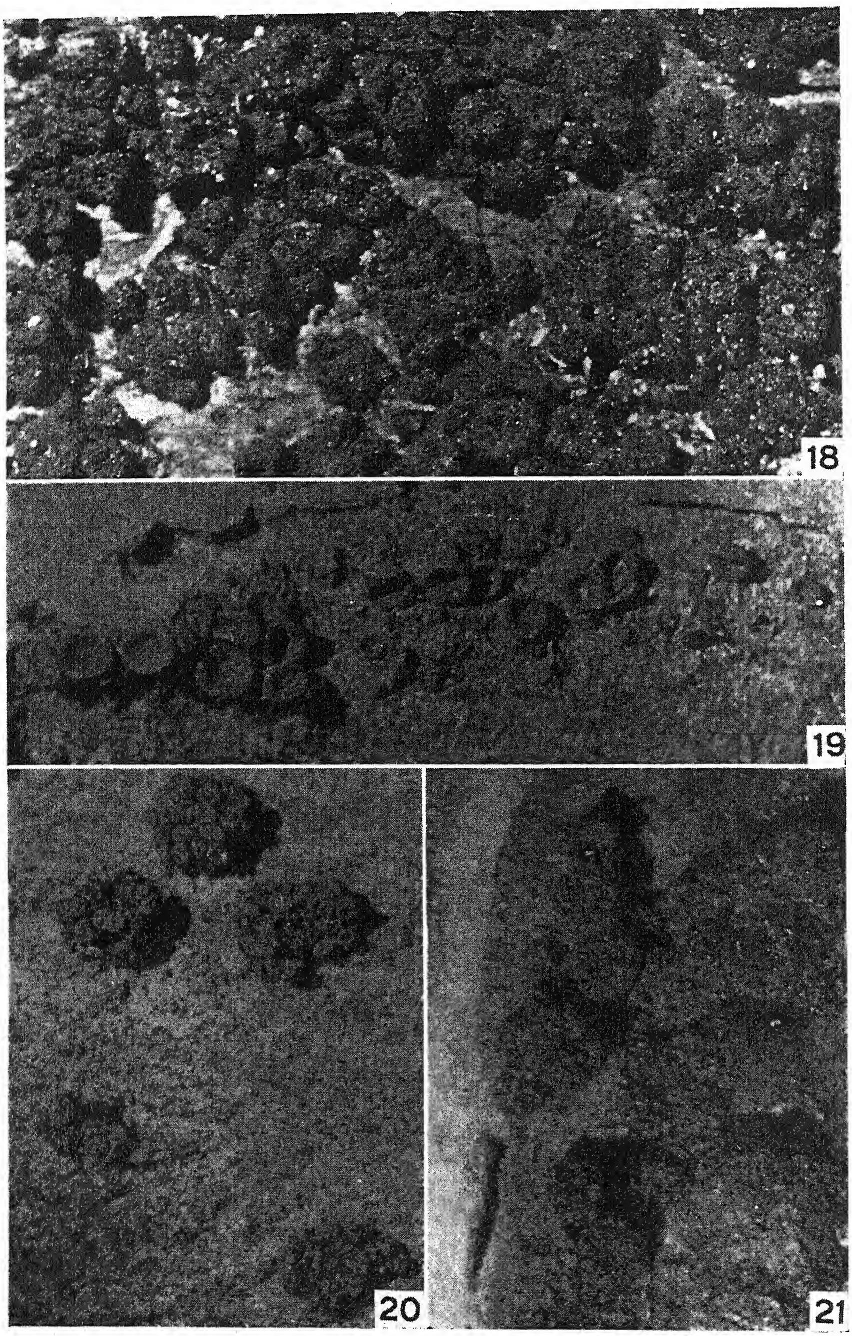
Fig. 38. *Calyculosphæria macrospora.* A perithecium in longitudinal section. × 43.



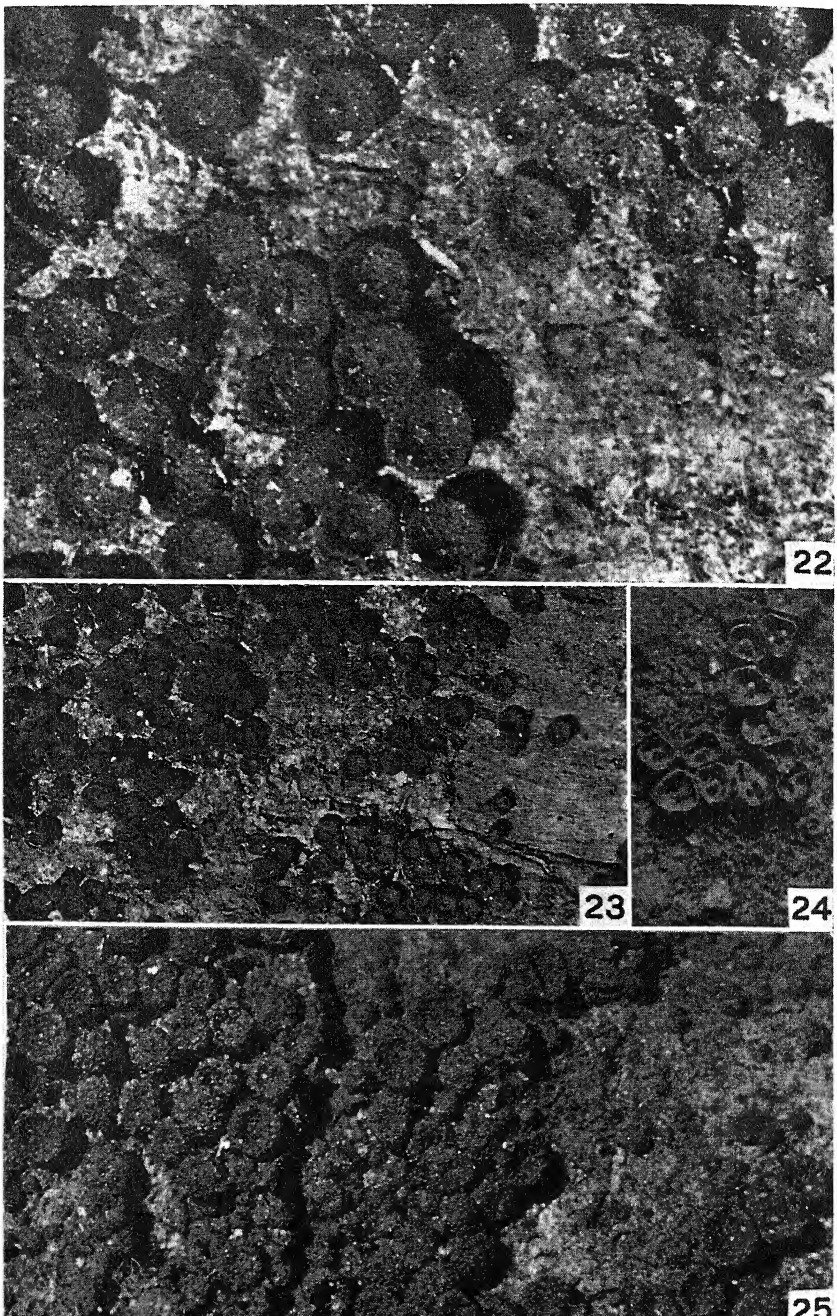
1–4. NITSCHKIA
5–8. CYATHISPHAERIA



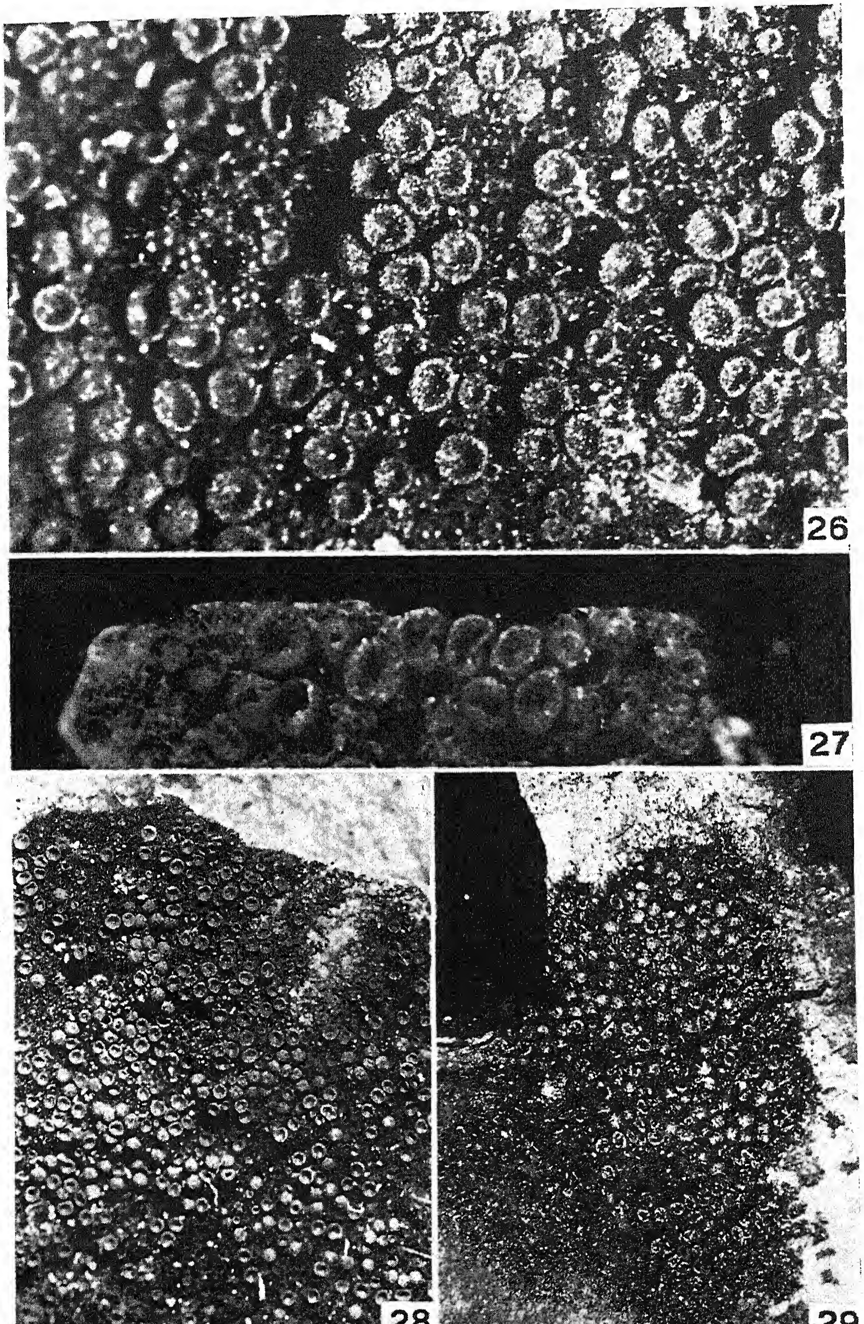
9, 10. THAXTERIA
11–15. ACANTHONITSCHKEA
16, 17. TYMPANOPSIS



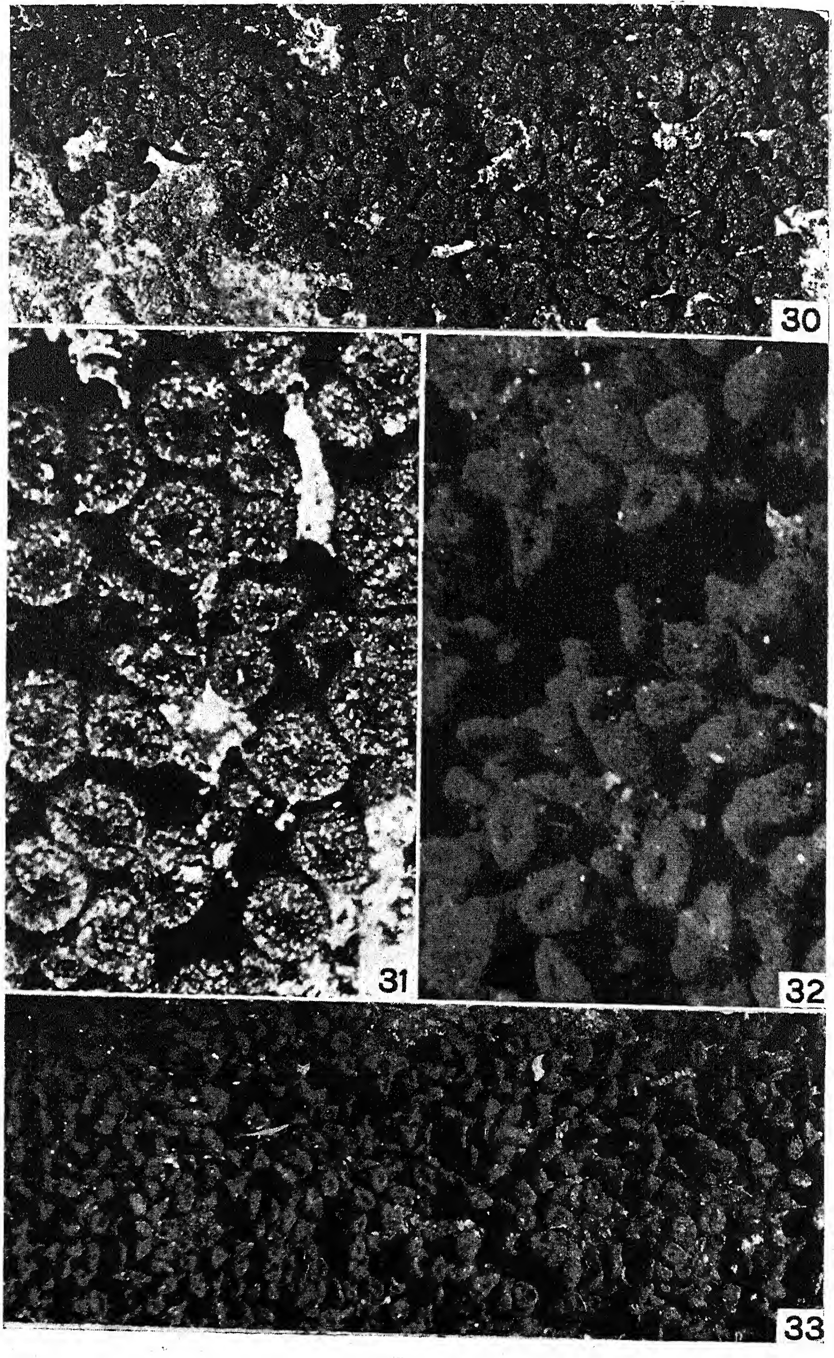
18–20. NITSCHKIA
21. CALYCULOSPHAERIA



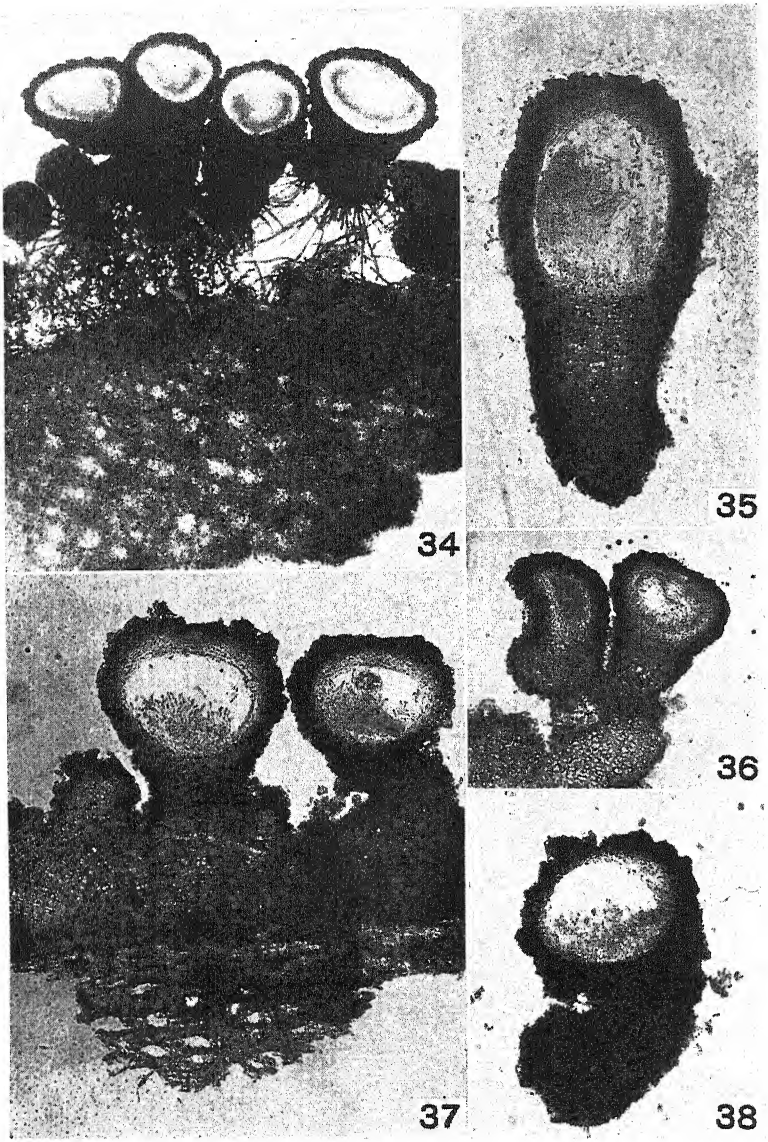
22–25. CALYCULOSPHAERIA



26–28. TYMPANOPSIS
29. ACANTHONITSCHKEA



30–33. Thaxteria



34, 38. Calyculosphaeria
35. Thaxteria
36, 37. Nitschkia

MYCOLOGIA

VOL. XV MARCH, 1923 No. 2

MONOGRAPH OF THE NITSCHKIEAE

HARRY MORTON FITZPATRICK

(*Continued from the January number*)

2. **Calyculosphaeria** nom. nov.

Winterella Berl. Ic. Fung. **1**: 94. 1894. Not *Winterella* Kuntze, Rev. Gen. **2**: 34. 1891. Not *Winterella* Sacc. Syll. Fung. **14**: 620. 1899.

Winterina Sacc. *emend.* Syll. Fung. **14**: 589. 1899. Not *Winterina* Sacc. Syll. Fung. **9**: 909. 1891.

Type species, *Nitschkia tristis* Fuckel.

Perithecia black, coriaceous-carbonaceous, turbinate, collapsing to cupulate, scattered to densely gregarious, arising from a hyphoid subiculum of coarse, brownish-black, iridescent hyphae, or seated on a well-developed pseudoparenchymatous stroma, usually prominently tuberculate, in one species strigose, apically ostiolate; ostiolum obscure to papilliform; asci thin-walled, evanescent, 8-spored, clavate, tapering to a long thread-like stalk, in some species apically thickened; ascospores straight, fusiform to subcylindric, subbiseriate to crowded, hyaline, at maturity centrally 1-septate, sometimes appearing to be 3-septate due to the presence of guttulae separated by pseudosepta, in some cases slightly constricted.

The genus *Winterella* Berl. (5) was based on *Winteria tuberculifera* E. & E. Saccardo had previously used the name *Winterella* (64) for a subgenus of *Cryptospora* Tulasne, and Kuntze (44) elevated it to generic rank to replace *Cryptospora* Tulasne which is antedated by *Cryptospora* Karelin & Kirilow (1842), a genus of the Cruciferae. The name *Winterella* is, therefore, untenable for Berlese's genus.

[MYCOLOGIA for January (15: 1–44) was issued January 25, 1923.]

The genus *Winteria* Sacc. (66) is equivalent to *Hypocreopsis* Wint. (86), not Karst. (37), and is antedated by *Selinia* Karst. (38), a recognized genus of the Hypocreales. The name *Winteria* was later proposed by Rehm (56) for a subgenus of *Trematosphaeria.* He gave a subgeneric diagnosis, but employed the anomalous procedure of using the name in his binomials. Saccardo (64) gave the group generic rank, attributed it to Rehm, and incorporated it in the Hyalophragmiae of the Sphaeriaceae.

The genus *Winterina* Sacc. (64) was founded to include species differing from *Winteria* Rehm in the possession of muriformly septate spores, and embraced *W. crustosa* E. & E., *W. rhoina* E. & E., and *W. coerulea* E. & E. In *Winteria* as typical phragmosporic species Saccardo retained the type species *W. lichenoides* Rehm, *W. viridis* (Rehm) Sacc., *W. tuberculifera* E. & E., and others. Later, it having been demonstrated that *W. lichenoides* and *W. viridis* in reality possess muriform spores, Saccardo reversed his position and published *Winterina* Sacc. *emend.* to include the phragmosporic species. He excluded from the emended genus *W. coerulea* and included *W. tuberculifera* previously assigned to *Winteria.*

Later von Höhnel (31) in a critical revision of these genera found that the type species of the genus *Winteria, W. lichenoides* Rehm, as well as *W. viridis* Rehm, and *W. cembrincola* Rehm *in herb.* are lichens and fall in the genus *Microglaena.* The species *W. excellens* Rehm was found to be identical with *Odontotrema hemisphaericum,* and the other species of the genus were found to belong to widely separated genera. It is evident, therefore, that the generic name *Winteria* Rehm must be abandoned.

Although the genus *Winterina* Sacc. (1891) was founded to embrace muriform-spored species, only one of the three species included, *W. coerulea* E. & E., really has muriform spores. It should, therefore, be regarded as the type of the genus. Von Höhnel has shown that this species, *W. subcoerulescens, W. acuminans, W. intermedia,* and *W. laricina* are all identical. He has erected a new genus, *Mycoglaena,* to include the single species, *M. subcoerulescens* (Nyl.) v. Höhn. The generic name *Winterina* might better have been retained for it, especially since the

other two species included in *Winterina* have been shown by von Höhnel to lack muriform spores and to belong to *Leptosporella*. The name *Winterina* can not in any case be recognized for the emended genus of Saccardo, since it was applied earlier to another group.

The species *Winteria tuberculifera* E. & E. is the type of both *Winterina* Sacc. *emend.* and *Winterella* Berl. As originally described by Ellis (19) the spores are said to be "hyaline, 2–4-nucleate (becoming 1–3-septate ?)." The writer has examined them, however, under the best lenses and finds that only a single central septum is formed. The presence of large guttulae sometimes causes the appearance of additional pseudosepta. The species is, therefore, not phragmosporic. The writer finds it to be identical with *Nitschkia tristis* Fuckel.

Von Höhnel (35) in a revision of the allantoid-spored Sphaeriaceae calls attention to the fact that in many of the species included in the genus *Nitschkia* the spores are in reality straight rather than allantoid, and often appear 2-celled. A comparison of the spores of several of these species with those of *W. tuberculifera* led him to conclude that the genus *Nitschkia* is identical with *Winteria* Sacc. *emend.* Later (36) he discovered that the spores in *N. cupularis* are actually allantoid as originally described, and he reversed his decision and recognized *Nitschkia* and *Winterina* as separate genera, the latter having straight, uniseptate spores. In the present account two genera are recognized, but since the names *Winterina* and *Winterella* are untenable it has been necessary to select a new generic name.

KEY TO THE SPECIES OF CALYCULOSPHAERIA

A. Ascospores less than 12 μ in length.
- 1. Perithecium tuberculate, ostiolum obscure.
  - *a*. Perithecium strikingly tuberculate with large warts, not prominently stipitate. 1. *C. tristis* (Figs. 6, 25, 34).
  - *b*. Perithecium more minutely tuberculate, strikingly stipitate. 2. *C. calyculus*.
- 2. Perithecium strigose, ostiolum very evident. 3. *C. pezizoidea* (Figs. 7, 24).

B. Ascospores 12 μ or more in length.
- 1. Ascospores 12–17 x 3.5–7 μ, fusiform. 4. *C. collapsa* (Figs. 5, 22, 23).
- 2. Ascospores 36–45 x 12–14 μ, subfusiform to subcylindric, prominently constricted. 5. *C. macrospora* (Figs. 8, 21, 38).

1. **Calyculosphaeria tristis** (Fuckel) comb. nov.

? *Sphaeria tristis* Pers. Ic. Descr. Fung. **2**: 49. 1800. Not *S. tristis* Tode, Fungi Meckl. **2**: 9. *pl. 9, fig. 67 a–c.* 1791, which is the same as *S. phaeostroma* Dur. & Mont., and a *Chaetosphaeria.*

Nitschkia tristis Fuckel, Symb. Myc. 165. 1869.

Coelosphaeria tristis Sacc. Syll. Fung. **1**: 92. 1882.

Melanopsamma Grevillii Rehm, in Starbäck, Bih. Sv. Vet.-Akad. Handl. **16**(3)^3: 5. *pl. 1, fig. 1 a, b.* 1890.

Winteria tuberculifera E. & E. Proc. Acad. Phila. **1890**: 240. 1890.

Winterella tuberculifera (E. & E.) Berl. Ic. Fung. **1**: 94. 1892. (Incorrectly spelled *tuberculigera.*)

Winterina tuberculifera (E. & E.) Sacc. Syll. Fung. **14**: 589. 1899.

Nitschkia Winteriana Sacc. Mem. Accad. Sci. Padova **33**: 159. 1917.

Winterina tristis v. Höhn. Ann. Myc. **16**: 105. 1918.

ILLUSTRATIONS: Pers. Ic. Descr. **2**: *pl. 12, figs. 5, 6;* Bih. Sv. Vet.-Akad. Handl. **16**(3)^3: *pl. 1, fig. 1 a, b.* 1890.

(Figures 6, 25, 34)

Hyphoid subiculum profusely developed to scanty, composed of brownish-black threads, 7–9 µ in diameter, and of characteristic metallic iridescence; perithecia subcespitose or densely gregarious to scattered, forming black patches frequently several centimeters in diameter on the surface of the bark or decorticated wood, sometimes fringing crevices in the bark and appearing erumpent, variable in size, 360–750 µ (mostly 400–500 µ) in diameter, black, usually dull, glabrous, not strigose, strikingly tuberculate with large warts which in some collections measure 75–90 µ in diameter, in other cases less coarsely roughened, turbinate, finally apically depressed and collapsing to cupulate; the flattened apex not centrally papillate; ostiolum obscure; asci clavate, 8-spored, 16–35 x 5–7 µ (p. sp.), thin-walled except for a thickened apex, evanescent, tapering to a long thread-like base; spores not allantoid, straight, subcylindric to fusoid, hyaline, subbiseriate to crowded, 5–10 x 1.5–2.5 µ (mostly 6–8 x 2 µ), frequently bi- or quadriguttulate, at maturity 1-septate.

The original description (Tode 85) of *Sphaeria tristis* Tode is accompanied by figures illustrating crudely the perithecium and habit of growth. Fuckel (27) states that the species is identical with *S. phaeostroma* Dur. & Mont. and includes it in the genus *Chaetosphaeria.* He cites exsiccati specimens[11] and figures the spores. The species, as understood by Fuckel, possesses spheric, black perithecia seated on or partially buried in a prominent byssus from which arise numerous erect spines. The spores are 4-celled, the terminal cells hyaline, the central ones brown. The species is mentioned in recent literature as *Chaetosphaeria phaeostroma* (Dur. & Mont.) Fuckel or *C. tristis* (Tode) Schröt.

Persoon (54, 55) states in his description of *S. tristis* that he is in doubt whether his species is identical with that of Tode. He says that in his material the perithecia collapse to cupulate, and form an extensive crust over a hyphoid subiculum. A comparison of his illustrations with those of Tode indicates that the species are not the same, but the identification of either from the original descriptions is impossible. Fuckel regarded his species, *Nitschkia tristis* Fuckel, as identical with *S. tristis* Pers. and states that the species differs generically from *S. tristis* Tode. He does not say, however, that he saw the type material of either of these species. He cites exsiccati specimens[12] to illustrate *N. tristis* and figures an ascus and spores, the latter being shown as hyaline, allantoid, unicellular, and triguttulate. An examination of the two specimens cited, as represented in the herbarium at Harvard University, reveals the fact that they are not the same. Moreover, neither one can be said to agree fully with Fuckel's description and illustrations. The fungus in Fuckel, Fungi Rhenani *947,* is identical with that in Rabenhorst, Fungi Europaei *51,* and is, therefore, *Chaetosphaeria.* The citation of this specimen is an evident error. The material in Rabenhorst, Fungi Europaei *632,* agrees with the description given by Fuckel except that the spores are straight rather than allantoid and not constantly triguttulate. Examination of a specimen from the herbarium of Fuckel[13] at Harvard labelled *Coelosphaeria tristis* Sacc. shows material identical with that dis-

[11] Fuckel, Fungi Rhen. *2040* and Rab. Fungi Eur. *51.*

[12] Rab. Fungi Eur. *632,* and Fuckel, Fungi Rhen. *947.*

[13] Herb. Barbey-Boiss. *590.*

tributed by Rabenhorst, and since in these specimens the spores agree in size with the measurements given by Fuckel it seems logical to accept this material as authentic for his species, and to explain his statement that the spores are allantoid as due to faulty observation. Since type material of *S. tristis* Pers. is unavailable it seems best to base our concept of *Nitschkia tristis* Fuckel on Rabenhorst, Fungi Europaei *632*. Considerable misunderstanding has existed with reference to the identity of the species. The description and figures given by Berlese (5) seem to be based at least in part on material of *Sphaeria cupularis* Fries. Chentantais (11) calls attention to the state of uncertainty concerning the species and concludes that it is identical with *N. cupularis*.

Von Höhnel (36), basing his opinion on an examination of Rabenhorst, Fungi Europaei *632*, states that the spores in *N. tristis* are cylindric to fusiform, usually straight, 2-celled, and quadriguttulate. Winter (89) gave a diagnosis of the species based on a study of the same collection, but failed to note a septum in the spore. Von Höhnel emphasized the 2-celled character and transferred the species to the genus *Winterina*.

A comparison of the material in Rabenhorst, Fungi Europaei *632*, with specimens from the type collections of *Winteria tuberculifera* E. & E. and *Melanopsamma Grevillii* Rehm shows the three collections to be the same.

Although the type material of *N. Winteriana* Sacc. has not been studied, the species is regarded as identical with *N. tristis*. The author states that it is equivalent to the latter species as understood by Winter, and Winter bases his description on Rabenhorst, Fungi Europaei *632*.

MATERIAL EXAMINED

Rab. Fungi Eur. *632* (at Cornell Univ., Harvard Univ., and N. Y. Bot. Gard.).

Herb. Barbey-Boiss. *590*, *ex Herb.* Fuckel (at Harvard Univ.).

Vize, Micro-fungi Brit. *391* (at Harvard Univ.).

Rehm Herb., Mus. Bot. Stockholm, type material of *Melanopsamma Grevillii* Rehm sent for examination.

Ellis Herb. ex Dearness Herb. *1533*, type material of *Winteria tuberculifera* E. & E. (at N. Y. Bot. Gard.; also seen in Everhart Herb. & Gen. Herb. at Harvard Univ.).

Fitzpatrick Herb. *1531,* collected near Ithaca, New York, by H. Fitzpatrick; *1371,* collected at Ocala, Florida, by R. Thaxter; *1895,* collected at Daytona, Florida, by R. Thaxter; *1897,* collected at Maraval Valley, Trinidad, by R. Thaxter; *1900,* collected at St. Ann's Valley, Port of Spain, Trinidad, by R. Thaxter. (Material of each of these collections also deposited in Herb. R. Thaxter at Cambridge, Massachusetts.)

2. **Calyculosphaeria calyculus** (Mont.) comb. nov.

Sphaeria (*Caespitosa*) *calyculus* Mont. Ann. Sci. Nat. II. **14**: 322. 1840.

Sphaeria calyculus Mont. Syll. Crypt. 226. 1856.

Byssosphaeria calyculus (Mont.) Cooke, Grevillea **15**: 122. 1887.

Coelosphaeria (?) *calyculus* (Mont.) Sacc. Syll. Fung. **9**: 444. 1891.

Nitschkia calyculus (Mont.) Kuntze, Rev. Gen. 3^2: 501. 1898.

Winterina calyculus (Mont.) v. Höhn. Ann. Myc. **16**: 127. 1918.

ILLUSTRATIONS: Ann. Sci. Nat. II. **14**: *pl. 19, fig. 2;* Berl. Ic. Fung. **3**: *pl. 28.*

TYPE: In Herb. Mus. Paris. Leprieur *372.*

Subiculum of stiff black threads, perithecia gregarious over large areas or rarely cespitose, turbinate, short stipitate, $\frac{1}{3}$–$\frac{1}{2}$ mm. diam., rugose, collapsing to cupulate; asci clavate, 18–22 x 7–9 μ; spores fusoid, straight, 5–6 x 2–2.5 μ, hyaline, often biguttulate, becoming uniseptate.

The description has been prepared from the original diagnosis of Montagne and the description and figures of Berlese who examined the type collection. The writer has not seen material of the species, but there seems to be no basis for excluding it from the genus.

3. **Calyculosphaeria pezizoidea** (Pat. & Gaill.) comb. nov.

Coelosphaeria pezizoidea Pat. & Gaill. Bull. Soc. Myc. Fr. **4**: 106. 1889.

Nitschkia pezizoidea Kuntze, Rev. Gen. 3^2: 501. 1898.

Winterina pezizoidea v. Höhn. Ann. Myc. **16**: 105. 1918.

TYPE: In Herb. Gaill. *266:* a portion of the original collection in Herb. Mus. Paris sent for study by Patouillard.

(Figures 7, 24)

Hyphoid subiculum well developed but thin, formed of brownish-black threads, 7–8 μ in diameter, of pronounced metallic iridescence, and chiefly tightly appressed to the bark; perithecia very characteristic, turbinate, scattered to gregarious, 350–425 μ in diameter, black, not tuberculate, more or less strigose, collapsing to deeply cupulate, the papilliform ostiolum strikingly evident in the center of the cup; asci 8-spored, clavate, approximately 40 x 6–8 μ (p. sp.); spores hyaline, straight, fusoid to ovoid, at maturity with a single median septum, occasionally appearing constricted, 7–10 x 2–3 μ.

The species was collected by Gaillard at San Fernando, Venezuela, in September, 1887, on decaying bark, and is known only from the type collection.

4. **Calyculosphaeria collapsa** (Romell) comb. nov.

Bertia collapsa Romell, Bot. Not. **1889**: 24. 1889.
Herpotrichia collapsa Rehm, Hedwigia **42**: 176. 1903.
Trichosphaeria vagans Boud. Ic. Myc. 1: 2. 1904; *pl. 574.* 1910.
Nitschkia collapsa Chentantais, Bull. Soc. Myc. Fr. **34**: 47–73. 1918.

ILLUSTRATION: Boud. Ic. Myc. *pl. 574.*
TYPE: Romell, Fungi Scand. Exsic. *70.*

(Figures 5, 22, 23)

Hyphoid subiculum profusely developed to scanty, composed of dark-brown threads, 6–7 μ in diameter, sometimes lacking or uniting with the elements of the substratum to form a thin, black pseudostroma; perithecia scattered to densely gregarious, forming black patches on the bark, large, 450–750 μ in diameter, the cupulate character plainly evident to the naked eye, black, prominently tuberculate though less coarsely so than in *C. tristis,* turbinate, the rounded apex centrally and prominently papillate, collapsing to cupulate, the papilliform ostiolum then very evident at the center of the cup; asci narrow clavate, 8-spored, 40–70 x 9–12 μ (p. sp.), thin-walled except for the thickened apex, tapering to a thread-like stalk; spores straight, fusiform, hyaline, subbiseriate, 1-septate, 12–17 x 3.5–7 μ.

The relatively small number of collections of material examined probably fails to give us a broad conception of this species. The

spores vary considerably in size in the different specimens, but are similar in other respects, and the perithecia in the four collections are indistinguishable. The septation of the spores has been previously noted by Romell (62) and Chentantais (11). The fact that the species is not a *Bertia* was first noted by Starbäck (80), who recognized its affinities with the genus *Tympanopsis*.

MATERIAL EXAMINED

Romell, Fungi Scand. Exsic. *70*, type material of *Bertia collapsa* Romell (at Harvard Univ.).

Herb. W. R. Gerard; specimen collected by Plowright in 1873, labelled *Sphaeria tristis* Tode (at N. Y. Bot. Gard.).

Herb. N. Y. Bot. Gard. *445*, *482* (collected by G. H. Cunningham, Lake Papaetonga, Wellington, New Zealand, August 18, 1919); material deposited in Fitzpatrick Herb. as *2011* and *2012* respectively.

5. **Calyculosphaeria macrospora** sp. nov.

TYPE: In Herb. R. Thaxter, Cambridge, Massachusetts, collected by R. Thaxter, January, 1898, at Daytona, Florida (portion of type collection deposited in Fitzpatrick Herb. as *1893*).

(Figures 8, 21, 38)

Perithecia large, 500–600 μ in diameter, rugose with large, irregular warts, black, glabrous, shiny, scattered to gregarious, turbinate, collapsing apically but due to the extreme roughness of the wall not becoming definitely cupulate, ostiolum obscure, sometimes visible before collapse, the bases of neighboring individuals forming a definite pseudoparenchymatous stroma; asci clavate, thin-walled, tip not thickened, aparaphysate, tapering to a slender stalk, 8-spored, 110–155 x 35–40 μ (p. sp.); spores very large, straight, cylindric, hyaline, 2-celled, constricted at the septum, 36–45 x 12–14 μ, with rounded ends.

On bark of unknown tree. Known only from the type collection.

3. TYMPANOPSIS Starbäck, Bih. Sv. Vet.-Akad. Handl. 19(3)[2]: 24–26. *pl. 1, fig. 12 a–d.* 1894

Type species, *Sphaeria euomphala* B. & C.

Stroma absent; perithecia superficial, seated on or partially buried in a hyphoid subiculum; hyphae composing the subiculum brownish-black, with a beautiful metallic iridescence, abundantly branched, sinuous, as viewed under the compound microscope yellowish-brown to nearly opaque, supplied at regular intervals with thick septa; perithecia subspheric to turbinate, rounded above, obscurely ostiolate, collapsing to cupulate, scattered to densely gregarious, black, glabrous, minutely roughened or tuberculate, coriaceous-membranaceous to coriaceous-carbonaceous; asci broadly clavate to cylindric, 8-spored, aparaphysate; spores uniseriate to crowded, smoky-hyaline to yellowish-brown, smooth or minutely echinulate, ovoid to ellipsoid.

This genus is closely related to *Nitschkia* Otth, differing from it chiefly in the possession of colored spores.

KEY TO THE SPECIES OF TYMPANOPSIS

A. Ascus broadly clavate, spores crowded. 1. *T. euomphala* (Figs. 16, 27).
B. Ascus cylindric or clavate-cylindric, spores uniseriate or nearly so.
  1. Perithecia more than 400 µ in diameter, spores large, 18–20 x 10–12 µ, smooth. 2. *T. coelosphaerioides.*
  2. Perithecia less than 400 µ in diameter, spores small, 7–9 x 4.5–5 µ, minutely echinulate. 3. *T. uniseriata* (Figs. 17, 26, 28).

1. TYMPANOPSIS EUOMPHALA (B. & C.) Starbäck, Bih. Sv. Vet.-Akad. Handl. 19(3)[2]: 24–26. *pl. 1, fig. 12 a–d.* 1894

? *Sphaeria conferta* Schw. Syn. Fung. Carolinae superioris 45. 1822, and in Fries, Syst. Myc. **2**: 444. 1823, not *S. conferta* Fries, Syst. Myc. **2**: 435. 1823, and in Schw. Syn. Fung. Am. Boreali 209. 1832.

? *Sphaeria confertula* Schw. Syn. Fung. Am. Boreali 211. 1832.

Sphaeria euomphala B. & C. Grevillea **4**: 141. 1876.

Botryosphaeria euomphala Sacc. Syll. Fung. **1**: 462. 1882.

? *Byssosphaeria* (*Amphisphaeria*) *conferta* Cooke, Grevillea **15**: 81. 1887.

Byssosphaeria euomphala (B. & C.) Cooke, Grevillea **15**: 122. 1887.

Sphaeria craterella B. & Rav. in Cooke, Grevillea **15**: 122. 1887.

Sphaeria introflexa B. & Rav. in Herb. Curtis.

? *Amphisphaeria conferta* (Schw.) Sacc. Syll. Fung. **9**: 747. 1891.

Nitschkia euomphala (B. & C.) E. & E. N. Am. Pyren. 246. 1892.

? *Coelosphaeria Beccariana* Berl. & Pegl. Nuovo Giorn. Bot. Ital. **24**: 110. *pl. 7, fig. 3.* 1892.

Tympanopsis euomphala (B. & C.) Starbäck, Bih. Sv. Vet.-Akad. Handl. **19**(3)²: 24–26. *pl. 1, fig. 12 a–d.* 1894.

? *Trematosphaeria confertula* Ellis, Proc. Acad. Phila. **1895**: 25. 1895.

? *Nitschkia Beccariana* Kuntze, Rev. Gen. Plant. **3**²: 501. 1898.

? *Tympanopsis Beccariana* v. Höhn. Ann. Myc. **16**: 105. 1918.

ILLUSTRATIONS: Berl. & Pegl. Nuovo Giorn. Bot. Ital. **24**: *pl. 7, fig. 3;* Berl. Ic. Fung. **3**: *pl. 26, fig. 2;* Starbäck, Bih. Sv. Vet.-Akad. Handl. **19**(3)²: *pl. 1, fig. 12 a–d.*

(Figures 16, 27)

Hyphae of the subiculum forming a thin, appressed, rather inconspicuous network of indefinite extent, often covering the surface of the bark of decorticated wood to a distance of several centimeters; perithecia superficial on the subiculum, attached to it by prominent basal hairs, at its center densely gregarious but toward its rather indefinite margin becoming widely scattered, varying considerably in size, 280–500 μ in diameter, minutely roughened with definite tubercles, black, glabrous, collapsing to deeply cupulate; the ostiolum not evidently papillate, obscure; asci broadly clavate, thin-walled, evanescent, 20–25 x 9–11 μ (p. sp.), 8-spored, aparaphysate, tapering into a long, thread-like stalk; spores crowded, especially above, ovoid to ellipsoid, occasionally more narrowed toward one end, frequently flattened on one side or even concave so that a few spores seem slightly curved, 7–9 x 4–5 μ, frequently biguttulate and then sometimes appearing pseudoseptate, smoky-hyaline or darker, in mass yellowish-brown.

Schweinitz (73) described *Sphaeria conferta* from material collected on bark of the spice bush (*Lindera Benzoin*) at Salem, North Carolina. Fries (25) included the species in Systema Mycologicum, referring by number to the description of Schweinitz, but unfortunately applied the same binomial earlier in the volume to a wholly different fungus occurring on leaves. Schweinitz (74), having noted this duplication, changed the name of his own species to *Sphaeria confertula,* and retained the name *S. conferta* for the fungus described by Fries from leaves.

Sphaeria conferta Fries, as represented in the Schweinitz her-

barium, is, according to Ellis (20) and Farlow (22), immature *Sphaerella maculiformis*. *Sphaeria conferta* Schw. (73) has been the subject of considerable controversy, and the question of its identity with *S. euomphala* B. & C. has been raised. Cooke (14) examined a specimen in the herbarium of Berkeley labelled *S. conferta* Schw., and describes the spores as 2-celled, brown, and constricted. On the basis of his observations Saccardo (64) and Ellis (20) list the species in the genus *Amphisphaeria*. Starbäck (80) examined a Schweinitzian specimen in the herbarium of Fries and, though failing to find asci or spores, calls attention to its marked similarity in external aspect to *S. euomphala*. Ellis (18) examined a specimen in the herbarium of Schweinitz labelled *S. confertula*, found asci containing brown 3-septate spores, and describes the species as *Trematosphaeria confertula* (Schw.) Ellis. The material examined was collected at Bethlehem, Pennsylvania, on rotten wood and Ellis expresses doubt as to its identity with the North Carolina specimen on which Schweinitz founded *S. conferta*. Farlow (22) examined a Schweinitzian specimen of *S. conferta* from Salem, North Carolina, in the herbarium of Curtis, saw two sorts of spores, concluded from a review of the literature that an understanding of the species is hopeless, and recommends that it be placed permanently under *species ignotae*. He states, however, that the external resemblance to *S. euomphala* is marked.

The herbarium of Schweinitz contains a specimen labelled in his own handwriting "*Sphaeria confertula* L. v. S. Salem" which may reasonably be regarded as the type of the species. It is the same as the Schweinitzian specimen in the herbarium of Curtis, but is less fragmentary. Although the perithecia are not definitely cupulate, they agree well in size, shape, and surface characters with the uncollapsed individuals of *S. euomphala*. The spores are identical in the two cases, as are also the hyphae of the subiculum. Failure to find asci in the Schweinitzian specimens alone deters the writer from stating unqualifiedly that the species are the same.

Coelosphaeria Beccariana Berl. & Pegl. apparently also belongs here. The species is not represented in the herbarium of Saccardo, and no authentic material has been available to the writer. As described and figured (5) it agrees, however, fully with the

older species. It is noteworthy that the authors of the species fail to call attention to *S. euomphala* in their discussion of its relationships.

MATERIAL EXAMINED

Rav. Fungi Car. **4**: *54* (at N. Y. Bot. Gard., Harvard Univ., Missouri Bot. Gard., and Phila. Acad. Sci.).

Ellis Herb. N. Y. Bot. Gard. (*976, 1057, 1186,* all *ex Herb.* Morgan, the first labelled *Nitschkia tristis,* the others *Nitschkia euomphala*).

Schw. Herb. Phila. Acad. Sci. (*1508* labelled "*Sphaeria confertula* L. v. S. Salem"); (*1477* labelled *Sphaeria conferta* Fries, material collected at Bethlehem on leaves, very different from *1508* and not resembling *Tympanopsis*).

Curtis Herb. Harvard Univ. (*363 ex Herb.* Schw. same as *1508* in Herb. Schw.); (*1550, type* material of *Sphaeria euomphala* B. & C., *ex Herb.* Rav. *441*); (*1307 ex Herb.* Rav. *type* material of *S. euomphala,* labelled here *S. craterella* B. & C., and a second specimen bearing this number labelled *S. introflexa* B. & Rav.); (*865 ex Herb.* Peters, labelled *S. euomphala* B. & C.).

2. TYMPANOPSIS COELOSPHAERIOIDES Penz. & Sacc. Malpighia **11**: 394. 1897

ILLUSTRATION: Penz. & Sacc. Ic. Jav. *pl. 6, fig. 3.*

"*Peritheciis gregariis v. hinc inde in soros subaggregatis, superficialibus, carbonaceo-molliusculis, e globoso mox collabascendo concavo-patellaribus, minutissime rugulosis, nigris, 0.5–0.8 mm. diam., ostiolo vix manifesto, contextu grosse celluloso, fuligineo; ascis tereti-clavatis, apice rotundatis, breve stipitatis, 75–90 x 15–18, aparaphysatis, 8-sporis; sporidiis mono—v. distichis, ellipsoideis, 18–20 x 10–12, fuligineis.*

"*Hab. in corticibus, Depok. 4 I 97 (n. 207).—Secunda pulcri generis Starbackiani species.*"

It has not been possible to obtain material of this species for study. It is incorporated here because examination of the published description and figures reveals no character warranting its exclusion.

3. **Tympanopsis uniseriata** sp. nov.

TYPE: In Herb. R. Thaxter at Harvard Univ. (portion of the type collection deposited in Fitzpatrick Herb. as *1904*).

(Figures 17, 26, 28)

Subiculum prominent as a thin, flat, mycelial mat, covering areas several centimeters in diameter on the surface of the bark, margin not sharply delimited; hyphae 7–9 μ in diameter, profusely branched, procumbent on the substratum but also definitely aërial and abundantly provided with stiff, more or less erect branches which form a dense barricade and simulate spines; perithecia scattered to gregarious, partially embedded in the subiculum, attached to it by basal hairs, varying considerably in size, 200–350 μ in diameter, black, glabrous, shiny, prominently though minutely roughened, collapsing to cupulate; the rim of the cup rather thick; the ostiolum not evidently papillate, obscure; asci cylindric, 60–70 x 8–10 μ (p. sp.), 8-spored, aparaphysate, thin-walled; spores definitely uniseriate, not overlapping, variously oriented, frequently transverse, broadly ovoid to ellipsoid, occasionally more narrowed toward one end, 7–9 x 4.5–5 μ, frequently biguttulate and then sometimes pseudoseptate, smoky-hyaline to light-yellowish-brown, minutely echinulate; the echinulations more readily discernible on young, hyaline spores.

On the bark of unknown trees at Cocoanut Grove and Cutler, Florida.

In the possession of spiny spores the species differs strikingly from other members of this genus, and the erection on it of a new genus could perhaps be justified.

MATERIAL EXAMINED

Herb. R. Thaxter at Harvard Univ. *type*, collected by R. Thaxter at Cocoanut Grove, Florida, December 1897 (portion of type collection deposited as *1904* in Herb. Fitzpatrick); another collection made by R. Thaxter at Cutler, Florida, December 1897 (portion deposited as *1892* in Herb. Fitzpatrick).

4. THAXTERIA Sacc. Syll. Fung. 9: 687. 1891

Bizozzeria Speg. Fungi Puiggariani, Bol. Acad. Nac. Ci. Cordoba 11: 519. 1889. Not *Bizozzeria* Sacc. Atti Istit. Veneto Sci. VI. 3: 739. 1885.

Type species, *Coelosphaeria leptosporoides* Wint.

Perithecia superficial, scattered to densely crowded, turbinate to clavate, coriaceous-carbonaceous, ostiolate, the terminal broadened portion containing the subspheric, ascigerous cavity, the lower or stalked portion solid, and frequently fused with the bases of neighboring individuals forming a definite pseudoparenchymatous stroma, at maturity or on drying collapsing to cupulate or laterally shrunken; asci thin-walled, slender-clavate, very long-stipitate, 8-spored; spores broadly allantoid, remaining hyaline for a long time, finally 4-celled by transverse septa and dark brown.

The genus *Bizozzeria* Speg. (76) was based on the single species, *B. didyma* Speg. In the generic diagnosis Spegazzini states that the spores are grayish-green and uniseptate. Saccardo (67) had applied the name *Bizozzeria* previously to another group, and substitutes the name *Thaxteria* Sacc. (64) for Spegazzini's genus. His description is merely copied from that of Spegazzini, and he evidently did not study material. Lindau (45) and others have since been content to follow Saccardo.

Through the courtesy of Professor Spegazzini the writer has been enabled to examine the original collection of *B. didyma,* and has found that the spores at maturity are dark-brown and 4-celled by transverse septa. They agree strikingly with the spores of *Leptospora spermoides* var. *rugulosa* Rick, and these two species are clearly congeneric. Moreover, a comparison of the perithecia and spores of the last-named species with those of *Coelosphaeria leptosporoides* Wint. convinces the writer that these two species are identical, and should bear the name *Thaxteria leptosporoides* (Wint.) comb. nov.

Von Höhnel (32) noted the similarity of *Leptospora spermoides* var. *rugulosa* Rick to members of the genus *Nitschkia,* and incorporated the species in this genus, stating that this fungus is in reality not a variety of *L. spermoides* (Hoffm.) Fuckel. Later he (36) reversed his decision, included the variety in the parent species, and incorporated the species in the genus *Thaxteria* as *T. spermoides* (Hoffm.) v. Höhn. He also placed in *Thaxteria* three species of *Lasiosphaeria, L. solaris* (C. & E.) Sacc., *L. sublanosa* (Cooke) Berl., and *L. pseudobombarda* (Mont.) Berl. He is clearly in error in regarding *Leptospora spermoides* var. *rugulosa* Rick as a variety of *L. spermoides* (Hoffm.) Fuckel. Examina-

tion of material [14] of the parent species shows it to differ from the variety markedly in spore and perithecial characters, these being well illustrated by Berlese (5). Moreover, the three species of *Lasiosphaeria* are wholly unlike *Thaxteria*. Von Höhnel failed to note the fact that the spores of *Leptospora spermoides* var. *rugulosa* Rick finally become brown and 3-septate, even though the point was called to attention by Rick (61). Moreover, he (36) transfers *Coelosphaeria leptosporoides* Wint. to the genus *Leptosporella*.

KEY TO THE SPECIES OF THAXTERIA

A. Perithecia broadly turbinate, coarsely tuberculate, collapsing to cupulate.
1. *T. leptosporoides* (Figs. 9, 30, 31).

B. Perithecia clavate to narrow-turbinate, not tuberculate, collapse usually lateral.
2. *T. didyma* (Figs. 10, 32, 33, 35).

1. **Thaxteria leptosporoides** (Wint.) comb. nov.

Coelosphaeria leptosporoides Wint. Hedwigia **22**: 2. 1883.

Leptospora spermoides (Hoffm.) Fuckel var. *rugulosa* Rick, Ann. Myc. **3**: 17. 1905.

Nitschkia rugulosa (Rick) v. Höhn. Sitzungsber. K. Akad. Wiss. Wien **123**: 58, 59. 1914.

Leptosporella leptosporoides (Wint.) v. Höhn. Ann. Myc. **16**: 105. 1918.

TYPE: *Coelosphaeria leptosporoides* Wint. in Herb. Wint. at Berlin. (Material sent for the writer's examination.)

(Figures 9, 30, 31)

Perithecia broadly turbinate, 500–800 μ in diameter, black, shiny, very coarsely tuberculate, the individual tuberculations 50–100 μ in diameter, and prominently protruding, in age or on weathering tending to become brownish and slightly strigose, usually collapsing apically to definitely cupulate, more rarely laterally shrunken, the papilliform ostiolum much smaller than a single tuberculation but distinct; asci clavate, thin-walled, 75–95 x 14–17 μ (p. sp.), long-stipitate, 8-spored; spores broadly allantoid, often slightly more sharply curved at one end, for a long time remaining hyaline and unicellular, then 1-septate, and finally 4-celled by transverse septa and dark-brown, 20–30 x 6–7.5 μ.

[14] Rab. Fungi Eur. 2430.

MATERIAL EXAMINED

Herb. Wint. Berlin (*type* collection of *Coelosphaeria leptosporoides* Wint.).

Herb. Fitzpatrick *1992* (collected by C. E. Chardon, Maricao, Porto Rico).

Rick, Fungi austro-americani **2**: *41* (at Harvard Univ.).

2. THAXTERIA DIDYMA (Speg.) Sacc. Syll. Fung. **9**: 687. 1891

Bizozzeria didyma Speg. Bol. Acad. Nac. Ci. Cordoba **11**: 519. 1889.

TYPE: *Bizozzeria didyma* Speg. in Herb. Speg. Argentina. (Material sent for the writer's examination.)

(Figures 10, 32, 33, 35)

Perithecia clavate to slender-turbinate, 400–700 μ in diameter, black, not prominently tuberculate, the surface in age becoming brownish and fibrillose, ostiolate, the conical papilla small but evident, usually collapsing laterally, more rarely depressed apically but usually not becoming characteristically cupulate; asci as in the preceding species; spores differing in being slightly shorter, 20–25 x 6–7.5 μ.

This species known only from the type collection is perhaps identical with the preceding. However, until material of an intermediate character is found, it does not seem wise to unite them.

MATERIAL EXAMINED

Herb. Speg. Argentina (*type* collection of *Bizozzeria didyma* Speg.).

5. ACANTHONITSCHKEA Speg. Anal. Museo Nac. Buenos Aires III. **10**: 116, 117. *1 fig.* 1908

Type species, *Acanthonitschkea argentinensis* Speg.

Stroma absent; perithecia superficial, seated on a hyphoid subiculum; hyphae composing the subiculum brownish-black, with a beautiful metallic iridescence, abundantly branched, sinuous, densely entangled, as viewed under the compound microscope yellowish-brown to nearly opaque, supplied at regular intervals with thick septa, armed with prominent spines which point in many directions and form a dense barricade; spines rigid, straight, or

slightly sinuous, unbranched, non-septate, opaque, cylindric, tapering to the sharp-pointed apex, brownish-black to black, shiny, strikingly iridescent; perithecia turbinate, rounded above, ostiolate, collapsing to cupulate, scattered to densely gregarious, brownish to black, armed with spines similar to those on the mycelium, coriaceous-membranaceous to coriaceous-carbonaceous; asci clavate, tapering to a long thread-like stalk, thin-walled, evanescent, 8-spored, aparaphysate; spores biseriate to crowded, hyaline, unicellular, inequilateral to allantoid.

This genus is closely related to *Nitschkia* Otth, differing from it in the possession of spiny perithecia.

KEY TO THE SPECIES OF ACANTHONITSCHKEA

A. Ascospores allantoid; perithecia 230–275 μ in diameter; spines 6–11 x 115–150 μ. 1. *A. argentinensis* (Figs. 11, 12).

B. Ascospores ellipsoid to subfusoid, inequilateral; perithecia 300–400 μ in diameter; spines 12–20 x 250–325 μ. 2. *A. macrobarbata* (Figs. 13, 14, 15, 29).

1. ACANTHONITSCHKEA ARGENTINENSIS Speg. Anal. Museo Nac. Buenos Aires III. **10**: 116. *1 fig.* 1908

ILLUSTRATIÓN: Speg. Anal. Museo Nac. Buenos Aires III. **10**: *1 fig.* 1908.

TYPE: In Herb. Speg. La Plata, Argentine. The specimen was mailed to the writer by Professor Spegazzini, and was found to be in excellent condition. A slide showing the microscopic characters is deposited in the herbarium of the writer.

(Figures 11, 12)

Subiculum sparse to well developed, covering areas of indefinite extent on the surface of the bark, hardly 1 mm. in thickness, margin not sharply delimited, mycelial mat flat rather than pulvinate; hyphae 6–8 μ in diameter; spines 6–11 x 115–150 μ; perithecia scattered to densely gregarious, 230–275 μ in diameter, not buried in the subiculum, attached to it by basal hairs, not wooly, glabrous, black, shiny, minutely tuberculate, armed with spines identical with those on the mycelium, collapsing to deeply cupulate; the rim of the cup circular and thin; the ostiolum not evidently papillate either before or after the collapse, obscure; spines much less prominent than in the following species; asci 16–20 x 6–10 μ; ascospores allantoid, slightly to very markedly curved, ends obtuse, 6–8 x 2 μ.

On the bark of *Ilex paraguayensis* in Argentina and *Cajanus indicus* in Porto Rico.

MATERIAL EXAMINED

Argentina: Herb. Speg. (*type* collected near Cuias).
Porto Rico: Herb. Fitzpatrick *1890* (*ex Herb.* J. A. Stevenson *5065;* collected at Pueblo Viejo).

2. **Acanthonitschkea macrobarbata** sp. nov.

TYPE: In Herb. R. Thaxter at Harvard Univ. (a portion of the type collection deposited in Herb. Fitzpatrick as *1958*).

(Figures 13, 14, 15, 29)

Subiculum prominent, developed on the surface of the bark as a sharply delimited, pulvinate mat, approximately 1 cm. in diameter and 1–2 mm. in thickness; hyphae 8–12 μ in diameter; spines 250–325 x 12–20 μ; perithecia densely gregarious, 300–400 μ in diameter, not buried in the subiculum, heaped up on it, forming a convex colony containing several hundred individuals, not evidently tuberculate, slightly wooly, the rounded end provided with a papilliform ostiolum which later becomes umbilicate, finally collapsed to cupulate (the rim of the cup rather thick), often compressed to elliptic or somewhat angular, armed with about a dozen prominent spines identical with those on the mycelium, brownish-black, somewhat lighter-colored and less evidently iridescent than the hyphae and spines; asci 16–22 x 6–7 μ; ascospores ellipsoid to subfusoid, inequilateral, often flattened on one side, ends rounded, 5–8 x 2.5–3 μ, not curved.

On bark of unidentified tree in St. Ann's Valley, Port of Spain, Trinidad, British West Indies. Collector, Roland Thaxter.

Differing from the type species chiefly in its larger perithecia, larger spines, and in the shape of the spores.

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THE LICHENS OF THE ISLE OF PINES

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The collection of lichens forming the basis of the present paper was made by Dr. and Mrs. N. L. Britton and Mr. Percy Wilson in February and March, 1916. A few specimens were collected by Dr. O. E. Jennings in 1910. The collection is of unusual interest on account of the large representation, 67 numbers in all, of rock-inhabiting lichens. Very little is known about the rock lichens of the West Indies. The only important collection of them, hitherto, was made by W. R. Elliott in the islands of Dominica and St. Vincent in 1891 and 1892; an account of Elliott's collections being given by Wainio in the London Journal of Botany for 1896. Charles Wright's rich collection of the lichens of Cuba included very few specimens on rocks. This probably accounts, in part at least, for the relatively large number of new species described in this paper.

The lichen flora of the Isle of Pines, so far as known at present, includes 49 genera with 127 species, of which 1 genus, 14 species, and 1 variety are new. Of the new species, 11 grow on rocks. Three of the new species are already known from other tropical localities, and until the rock lichens of Cuba are known it is obviously impossible to say how many species are endemic in the Isle of Pines. For the same reason, comparison of the lichen flora of the Isle of Pines with that of other islands in the West Indies would, at present, be valueless. It can be stated, however, that the number of distinctively tropical species is very large.

In the following list, localities outside of the Isle of Pines are cited only in cases where the distribution is restricted or little known.

1. **Thrombium echinulosporum** sp. nov.

Thallus epilithicus crustaceus uniformis effusus linea nigra limi-

* Deceased Jan 16, 1921. Published essentially without change from manuscript left by the author.

tatus, virescens vel viridi-glaucescens opacus, crassitudine mediocris aut tenuis, continuus laevigatus. Gonidia pleurococcoidea. Perithecia nigra integra subglobosa, ad 0.5 mm. lata, dispersa, primum semiimmersa dein emergentia et nuda basi thallino-tecta apice umbilicata demum elabentia foveolamque relinquentia. Gonidia hymenialia nulla. Paraphyses persistentes ramoso-connexae. Asci cylindrices 8-spori. Sporae in ascis uniseriales incolores ellipsoideae simplices olim biguttulatae membrana sat crassa et echinulata, 20–30 x 8–12 μ.

On limestone, Cerros de Vivijagua, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 28–29, 1916, *15050* (type); on limestone, Sierra de las Casas, N. L. Britton and Percy Wilson, March 22, 1916, *15749, 15750*. *Thrombium echinulosporum* is apparently quite distinct from all other species of the genus.

2. **Microglaena Brittonii** sp. nov.

Thallus epilithicus crustaceus uniformis effusus haud limitatus, glaucus opacus, sat tenuis continuus laevigatus. Gonidia pleurococcoidea. Perithecia hemisphaerica, verrucas circ. 0.4 mm. latas dispersas aut partim approximatas convexas thallo obductas basi sensim in thallum abeuntes radiatim fissuratas ochroceulas formantia, ostiolo punctiforme fulvo, amphithecio superne fulvo inferne incolore, demum elabentia foveolamque relinquentia. Gonidia hymenialia nulla. Paraphyses persistentes simplices aut apicibus sparse ramosis. Asci clavati 8-spori. Sporae in ascis biseriales aut irregulares, incolores ellipsoideae aut oblongae muriformes 8-loculares loculis cubicis, 20–27 x 10–18 μ.

On limestone, Sierra de las Casas, collected by N. L. Britton and Percy Wilson, March 22, 1916, *15743* (type); also *15747, 15751;* Sierra de los Caballos, same collectors, March 2, 1916, *15152;* Vivijagua, same collectors, Feb. 20, 1916, *15048*.

This species is most closely related to **Microglaena scopularis** (Wainio) comb. nov. (*Thelenella* Wainio, Jour. Bot. 34: 293. 1896), but differs in the thallus being continuous instead of broken into areoles and in the upper part of the amphithecium being fulvous instead of brownish-black. From both *M. brasiliensis* Muell. Arg. (Flora 71: 547. 1888) and *M. saxicola* Muell. Arg. (Proc. Roy. Soc. Edinburgh 11: 471. 1882) this new species differs in the color as well as the continuity of the thallus. I take pleasure in naming this in honor of Dr. N. L. Britton.

3. ARTHOPYRENIA CINCHONAE (Ach.) Muell. Arg. On *Savia sessiliflora*, Cerro San Juan del Mar, Colombia, *14674;* on *Savia*, Sierra de los Caballos, *15146;* on *Thrinax*, Vivijagua, *15083*.

4. ARTHOPYRENIA CONOIDEA (Fr.) Zahlbr. On limestone, Caleta Cocodrilos, *15290*.

5. ARTHOPYRENIA PLANORBIS (Ach.) Muell. Arg. On *Tabebuia*, Vivijagua, *15596*.

6. ARTHOPYRENIA TUMIDA Muell. Arg. in Revis. Lich. Eschweiler. Flora 67: 669. 1884. On *Coccothrinax*, La Cañada, *14425, 14427*. Brazil.

There has been no material available for comparison, but the specimens agree well with Mueller-Argau's original description.

7. **Monoblastia** gen. nov.

Thallus crustaceus uniformis ecorticatus, gonidiis chroolepoideis. Perithecia solitaria nigra, ostiolo recto terminale. Paraphyses persistentes crassiusculae ramoso-connexae. Asci cylindrices. Sporae in ascis uniseriales, incolores sat magnae simplices, membrana crassiuscula laevigata.

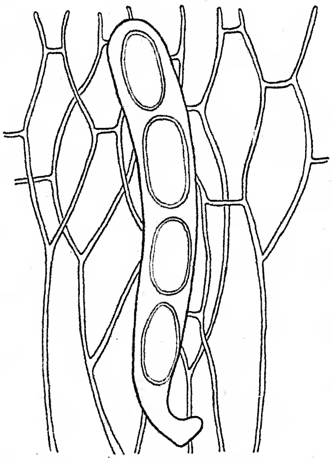


FIG. 1. *Monoblastia palmicola*. Ascus with spores and paraphyses.

This new genus belongs to the family Pyrenulaceae, as defined by Zahlbruckner in Engler and Prantl, Die Natürlichen Pflanzen-

familien I[1]*: 62. 1903. The only other genus of that family having simple spores is *Coccotrema* Muell. Arg. in Mission Scientifique au Cap Horn 5: 171. 1889, which is described as having "paraphyses liberae tenues flaccidae," and Pertusaria-like verrucae often containing two or three perithecia. It is obvious that the characters of the plant from the Isle of Pines are generically distinct from those of *Coccotrema*. The genus is named *Monoblastia* in reference to the one-celled spores, a rare type in the Pyrenulaceae, and in analogy to *Polyblastia*, which has many-celled spores.

Monoblastia palmicola sp. nov.

Thallus epiphloeodes crustaceus uniformis effusus haud limitatus, albidus tenuis laevigatus continuus aut majore parte diffractus, KOH non reagens. Gonidia copiosa chroolepoidea. Perithecia circ. 0.5 mm. lata, dimidiata alte hemisphaerico-convexa basi innata cetero superficialia nuda nigra opaca, ostiolo minute umbilicato; amphithecio carbonaceo basi incompleto. Asci cylindrices 2–4-spori. Sporae ellipsoideae aut oblongae, 30–50 x 16–20 μ.

On *Thrinax*, Rocky Point, Ensenada de Siguanea, collected by N. L. Britton and Percy Wilson, March 13, 1916, *15423* (type).

8. PORINA FIRMULA Muell. Arg. On limestone, Cerro San Juan del Mar, Columbia, *14683;* on limestone, Cerros de Vivijagua, *15047*. Cuba.

9. **Porina** (Sect. Sagedia) **macrocarpa** sp. nov.

Thallus epilithicus crustaceus uniformis effusus linea nigra limitatus, glaucus virescens aut purpurascens opacus, crassitudine mediocris, aut tenuis, continuus laevigatus, olim spermagoniis nigropunctatus. Gondia chroolepoidea. Perithecia 1.0–1.5 mm. lata, solitaria aut confluentia dimidiata primum immersa leviter convexa dein emergentia elevata conico-hemisphaerica basi innata, nigra sat tenue thallino suffusa aut denudata, apice obtusa aut crasse papillata, demum elabentia foveolamque relinquentia, amphithecio carbonaceo basi deficienti. Paraphyses persistentes tenues simplices. Asci cylindrices 8-spori. Sporae in ascis uniseriales, incolores ellipsoideae, 4-loculares loculis subcylindricis angulis sat rotundatis, 13–16 x 5–7 μ. Spermagonia mediocria nigra apicibus emergentibus denudatis. Spermatia filiformia arcuata, 18–22 x 1 μ.

On limestone, Key View Hill, Vivijagua, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 28–29,

1916, *15090* (type); Sierra de los Caballos, N. L. Britton and Percy Wilson, March 2, 1916, *15151;* Sierra de las Casas, same collectors, March 22, 1916, *15740.* Also on limestone, Cockburn Town, Watling's Island, Bahamas, N. L. Britton and C. F. Millspaugh, March 12–13, 1907, *6131;* and on limestone, Loiza, Porto Rico, N. L. Britton, B. H. Dutcher, and Stewardson Brown, March 23, 1915, *5745*.

The affinities of this species seem on the whole to be with the genus *Porina,* although it has peculiarities which make its systematic position somewhat uncertain. While the perithecia are for the most part solitary, they occur occasionally completely confluent except for the projecting papillate tips. The cells of the quadrilocular spores are somewhat more rounded than is typical for *Porina.* There is no other species with which this is liable to be confused.

10. PORINA MASTOIDEA (Ach.) Mass. On bark, San Juan, *15564.*

11. PORINA NUCULA Ach. On bark of *Oxandra,* Sierra de las Casas, *15758;* on rock (!), San Juan, *14998a.* I find no record of the occurrence of this species on rocks, but the specimen from San Juan offers no characters except the habitat to distinguish it from this species. But, as noted below, two normally bark-inhabiting species, *Lecidea pyrrhomelaena* and *Bombyliospora domingensis,* occur on rocks in the Isle of Pines, the identity of the bark-inhabiting and rock-inhabiting plants being beyond question in those two cases.

12. **Porina** (Sect. Segestria) **subfirmula** sp. nov.

Thallus epilithicus determinatus subfoliosus effiguratus irregularia rotundatus margine integro aut crenato haud lobato, planus arcte adnatus crassus (crassitudine 0.15–0.2 mm.), atro-olivaceus, continuus laevigatus vel sat inaequalis nitidulus; superne corticata cortice tenue (crassitudine 12–14 μ) pseudoparenchymatica, inferne ecorticata. Gonidia chroolepoidea. Perithecia subglobosa circ. 0.3 mm. lata, tota immersa aut apicibus leviter emergentibus et sat denudatis, amphithecio superne nigro inferne decolore. Paraphyses persistentes simplices. Asci 8-spori. Sporae incolores fusiformes, haud bene evolutae, 6–8-loculares, loculis cylindricis, circ. 25 x 4 μ.

On limestone, Sierra de las Casas, collected by N. L. Britton and Percy Wilson, March 22, 1916, *15741* (type).

This species is evidently related to, but quite distinct from, the remarkable *Porina firmula* Muell. Arg., in which the olivaceous, subfoliose thallus has convex lobes and is merely loosely adherent to the substratum. The present species is decidedly *Endocarpon*-like in habit.

13. PORINA TETRACERAE (Ach.) Muell. Arg. On rocks, Cerros de San Juan, *15504*. Another instance of an unusual habitat.

14. PORINA VARIEGATA Fée. On *Thrinax*, Rocky Point, Ensenada de Siguanea, *15417*.

15. **Porina** (Sect. Sagedia) **Wilsonii** sp. nov.

Thallus epilithicus crustaceus uniformis effusus haud limitatus, cretaceo-albus opacus tartareus, crassiusculus continuus laevigatus spermagoniis copiose nigropunctatus. Gonidia chroolepoidea. Perithecia globosa integra nigra 0.6–0.8 mm. lata, primum tota immersa maculis nigrescentibus indicata dein semiemergentia alte convexa strato tenue thallode fere ad instar pruinae velata demum apicibus denudatis, ostiolo minute umbonato, nunquam elabentia. Paraphyses persistentes tenues simplices. Asci cylindrices 8-spori. Sporae in ascis uniseriales, incolores fusiformes 4-loculares loculis cylindricis, 13–15 x 4–5 μ. Spermagonia minuta nigra apicibus emergentibus denudatis. Spermatia recta bacillaria, 3–5 x 1 μ.

On limestone, Caleta Cocodrilos, collected by N. L. Britton, Percy Wilson, and Brother Leon, March 8, 1916, *15288* (type).

This species, which I take pleasure in naming in honor of Mr. Percy Wilson, may be distinguished from other species of the section *Sagedia* by the chalky-white, tartareous thallus and the size of the perithecia, which are relatively large for the genus.

16. PYRENULA AURANTIACA Fée. On Plumeria, Vivijagua, *15085*.

17. PYRENULA COSTARICENSIS Muell. Arg. On *Calyptrogyne*, vicinity of Santa Barbara, *14767*. Costa Rica, Venezuela. There has been no material for comparison and the determination is not certain.

18. PYRENULA LEUCOPLACA (Wallr.) Koerb. On *Annona*, Vivijagua, *15599*.

19. ANTHRACOTHECIUM LIBRICOLUM (Fée) Muell. Arg. On *Lysiloma,* Vivijagua, *15041* in part; on *Lonchocarpus,* same locality, *15038* (old).

20. ANTHRACOTHECIUM OCHRACEOFLAVUM (Nyl.) Muell. Arg. Vivijagua, on *Thrinax, 15081,* on *Lysiloma, 15042, 15600;* on *Thrinax,* Rocky Point, Ensenada de Siguanea, *15421;* on *Omphalea,* Punta Columba, *15645a, 15648.* This is a variable species, the thallus varying in color from vitelline-yellow to rusty-orange, and the spores varying considerably in size and in number of cells.

21. ANTHRACOTHECIUM PALMARUM (Krempelh.) Muell. Arg. On *Thrinax,* Vivijagua, *15083* in part. Venezuela, Samoa. This is a little know but easily recognizable species, distinguished from the preceding species by the brick-red tint of the thallus and by the shorter spores with irregularly placed cells.

22. ANTHRACOTHECIUM PYRENULOIDES (Mont.) Muell. Arg. On *Annona,* vicinity of Siguanea, *14389.*

23. MELANOTHECA ACHARIANA Fée. On *Savia sessiliflora,* Cerro San Juan del Mar, Columbia, *14672.* Cuba, Virgin Islands, Guiana, Venezuela.

24. MELANOTHECA CRUENTA (Mont.) Muell. Arg. On bark, San Juan, *15563.*

25. TRYPETHELIUM AENEUM (Eschw.) Zahlbr. On *Byrsonima,* Sierra de la Cañada, *14428.* Florida, Bahamas, Cuba, Costa Rica, Brazil.

26. TRYPETHELIUM CATERVARIUM (Fée) Tuck. On *Annona,* vicinity of Siguanea, *14384.* Alabama, Bahamas, Cuba, Porto Rico, Costa Rica.

27. TRYPETHELIUM ELUTERIAE Spreng. On *Peltophorum,* vicinity of Siguanea, *14383;* on *Lysiloma bahamensis,* Boqueron, Ensenada de Siguanea, *14538.*

TRYPETHELIUM ELUTERIAE NIGRICANS (Fée) Muell. Arg. On *Hippomane,* Rocky Point, Ensenada de Siguanea, *15410.*

28. TRYPETHELIUM INFUSCATULUM Muell. Arg. On *Anacardium*, vicinity of San Pedro, *14340*. Cuba.

29. TRYPETHELIUM MASTOIDEUM Ach. On *Exostema*, Caleta Cocodrilos, *15327*.

30. TRYPETHELIUM OCHROLEUCUM PALLESCENS (Fée) Muell. Arg. On *Hippomane*, Rocky Point, Ensenada de Siguanea, *15408*.

31. TRYPETHELIUM OCHROTHELIUM Nyl. On *Peltophorum*, vicinity of Siguanea, *14383a;* on *Tabebuia*, Loma la Daguilla, *15183;* on *Curatella*, Cerro de la Jia, *15210*. Bahamas, Colombia.

32. TRYPETHELIUM PAPILLOSUM Ach. On *Xylopia grandiflora*, La Cunagua, *14576*. Cuba, Guiana, Guinea, tropical Africa.

33. TRYPETHELIUM TROPICUM (Ach.) Muell. Arg. On orange, La Cunagua, *14588a;* on *Hippomane*, Rocky Point, Ensenada de Siguanea, *15409*.

34. PARATHELIUM INDUTUM Nyl. On *Omphalea*, Punta Columba, Vivijagua, *15646*. Porto Rico, St. Thomas, Colombia.

35. PLEUROTHELIUM INCLINATUM Muell. Arg. On *Celtis*, Vivijagua, *15077*. Cuba.

36. HEUFLERIA SEPULTA (Mont.) Trev. On *Genipa*, San Juan, *15565*. Cuba, Jamaica, Guiana, Brazil, Peru.

37. **Phylloporina dilatata** (Wainio) comb. nov.
Porina dilatata Wainio Lich. Brés. 2: 227. 1890.

On leaves of *Jambos*, Sierra de las Casas, *15768*. Brazil.

38. PHYLLOPORINA PHYLLOGENA Muell. Arg. On leaves of *Rheedia*, San Juan, *15487;* on leaves of *Jambos*, La Cunagua, *14595*.

39. STRIGULA ANTILLARUM (Fée) Muell. Arg. On leaves of *Jambos*, Sierra de las Casas, *15768a*.

40. STRIGULA ELEGANS (Fée) Muell. Arg. On leaves of *Gymnanthes*, Cerros de Vivijagua, *15022;* same habitat. Sierra

de las Casas, *15764;* on leaves of *Pseudolmedia spuria,* San Juan, *15559.*

STRIGULA ELEGANS INTERMEDIA Muell. Arg. On leaves of *Hirtella,* La Cunagua, *14593b.*

41. STRIGULA PLANA Muell. Arg. On leaves, San Juan, *15558.* Cuba, Costa Rica, Venezuela. Wainio (Lich, Brés. **2**: 229. 1890) considers this synonymous with the preceding species.

42. MYCOPORELLUM ESCHWEILERI Muell. Arg. Revis. Lich. Eschweiler. in Flora **71**: 526. 1888. On *Pachyanthus,* vicinity of Los Indios, *14183.* Brazil. There has been no material available for comparison, but the specimen agrees well with Mueller-Argau's original description.

43. ARTHONIA COMPLANATA Fée. On *Calyptrogyne,* vicinity of San Pedro, *14486.*

44. ARTHONIA MICROSPERMA Nyl. On *Bumelia,* Rocky Point, Ensenada de Siguanea, *15412.* Cuba.

45. ARTHONIA POLYMORPHA Ach. Vivijagua, on *Lonchocarpus, 15037, 15038a, 15039;* on *Ichthyomethia, 15084;* on *Omphalea, 15647.*

46. ARTHOTHELIUM CHLOROLEUCUM Muell. Arg. On *Thrinax,* Rocky Point, Ensenada de Siguanea, *15420.* A striking and beautiful species, known previously from the original collection only, made by Charles Wright in Cuba.

47. ARTHOTHELIUM SPECTABILE (Flot.) Mass. On *Mangifera,* San Pedro, *14823;* on limestone, Sierra de las Casas, *15738.*

48. OPEGRAPHA ACICULARIS Riddle Mem. Brooklyn Bot. Gard. **1**: 110. 1918. On *Thrinax,* Vivijagua, *15082;* on *Omphalea,* Punta Columba, Vivijagua, *15644.* Bahamas, Porto Rico, St. Thomas.

49. OPEGRAPHA BONPLANDI Fée. On *Oxandra,* Cerros de San Juan, *14994;* on *Thrinax,* Rocky Point, Ensenada de Siguanea, *15419;* on bark, Vivijagua, O. E. Jennings, *123a.*

50. OPEGRAPHA CALCAREA Turn. On limestone, Caleta Cocodrilos, *15289.*

51. OPEGRAPHA LITHYRGA Ach. On limestone, Rocky Point, Ensenada de Siguanea, *15427*.

Opegrapha lithyrga notha var. nov.

Thallus ut in forma typica. Apothecia 0.5–1.5 mm. longa, aggregata, mox disco aperto plano, demum lirellis confluentibus subdifformibus. Sporae ut in forma typica.

On limestone, Sierra de las Casas, N. L. Britton and Percy Wilson, March 22, 1916, *15745* (type). Apart from the apothecia, this material offers no characters to distinguish it from *Opegrapha lithyrga* Ach. The proposed variety bears the same relation to the species as the var. *notha* (Ach.) Fr. to *O. varia* Pers. and the var. *arthonoidea* Leight. to *O. atra* Pers. It is probable that *Opegrapha lithyrgiza* Wainio Lich. Brés. **2**: 132. 1890, is a synonym. But the plant is certainly not of valid specific rank.

52. **Opegrapha oleaginea** sp. nov.

Thallus epilithicus crustaceus uniformis subdeterminatus, fuligineus aut partim nigro-brunneus partim umbrinus linea obscuriore limitatus, crassitudine tenuis aut mediocris, continuus laevigatus quasi oleagineus. Apothecia lirelliformia pro maxima parte 0.5–1.0 mm., rarius ad 3 mm., longa, gracilis circ. 0.2 mm. lata, sessilia vel sat elevata, recta aut rarius sat flexuosae, nigra, disco rimaeformi labiis integris laevigatis conniventibus; amphithecio nigro basi integri; epithecio fusco, hymenio et hypothecio fusco tincto. Asci clavati 8-spori. Sporae in ascis biseriales aut irregulares, incolores fusiformes 4-loculares loculis cylindricis, 15–18 x 4–5 μ.

On limestone, Sierra de las Casas, N. L. Britton and Percy Wilson, March 22, 1916, *15739* (type).

The dark color and oily appearance of the thallus will serve to distinguish this species from others of the genus having four-celled spores.

53. OPEGRAPHA PROSODEA Ach. On *Oxandra*, Cerros de San Juan, *14995*, *14996*.

54. OPEGRAPHA SAXICOLA Ach. On limestone, Cerros de Vivijagua, *15049*, *15052*, *15054*.

55. OPEGRAPHA VIRIDIS Pers. On *Thrinax*, Vivijagua, *15083a*. Not quite typical, as the thallus is almost white.

56. GRAPHIS AFZELII Ach. On *Annona palustris,* Siguanea, *14388;* San Pedro, on *Anacardium, 14484;* on *Calophyllum, 14485;* on orange, La Cunagua, *14588;* on *Swietinia,* Caleta Cocodrilos, *15325.*

57. GRAPHIS ELEGANS (Borrer) Ach. On *Purdiaea,* vicinity of Los Indios, *14229;* on *Icica,* San Pedro, *14826;* on *Annona,* vicinity of Siguanea, *14385;* on orange, La Cunagua, *14575, 14589;* on *Tabebuia,* San Francisco Heights, *15119;* on *Eugenia,* Sierra de los Caballos, *15141.*

58. GRAPHIS GLAUCESCENS Fée. On *Guazuma,* Cerro San Juan del Mar, Columbia, *14671.* Guadeloupe, Colombia, Brazil.

59. GRAPHIS NITIDA (Eschw.) Nyl. On *Oxandra,* Caleta Cocodrilos, *15279.* South Carolina, Alabama, Cuba, Guiana.

60. GRAPHIS PAVONIANA Fée. On *Coccolobis,* Vivijagua, *15643.*

61. GRAPHIS SCRIPTA (L.) Ach. On *Savia sessiliflora,* Cerro San Juan del Mar, Columbia, *14673;* on *Tabebuia,* Vivijagua, *15597.*

62. GRAPHIS TENELLA Ach. On *Lysiloma,* Vivijagua, *15041;* Sierra de los Caballos, *15148.*

63. GRAPHIS VESTITA Fr. On *Theaceae,* vicinity of Santa Barbara, *14778.* The original material of this species came from tropical America, but its exact distribution is uncertain.

64. GRAPHINA POITAEI (Fée) Muell. Arg. On bark, Cerro de la Jia, *15215.* St. Domingo, Costa Rica, Colombia.

65. GRAPHINA SOPHISTICA (Nyl.) Muell. Arg. On *Annona bullata,* Cerro de la Jia, *15212.*

66. GRAPHINA VIRGINEA (Eschw.) Muell. Arg. On *Exostema,* Caleta Cocodrilos, *15326.*

67. PHAEOGRAPHINA CINEREOPRUINOSA (Fée) Muell. Arg. On bark, Loma La Daguilla, *15167;* on *Hippomane,* Rocky Point, Ensenada de Siguanea, *15411.*

68. GLYPHIS CICATRICOSA Ach. On *Annona palustris,* Siguanea, *14386;* on *Lysiloma,* Boqueron, Ensenada de Siguanea, *14537;* on *Eugenia,* Sierra de los Caballos, *15142;* on *Exostema,* Caleta Cocodrilos, *15328.*

69. SARCOGRAPHA LABYRINTHICA (Ach.) Muell. Arg. On *Matayba,* vicinity of San Pedro, *14483.*

70. LECANACTIS AMERICANA Wainio. On *Gymnanthes,* Cerro San Juan del Mar, Columbia, *14675.* Brazil.

71. OCELLULARIA ACTINOTA (Tuck.) Muell. Arg. On *Lysiloma,* Sierra de las Casas, *15760.* Cuba, Jamaica.

72. OCELLULARIA GRANULOSA (Tuck.) Muell. Arg. On *Calyptrogyne,* vicinity of Santa Barbara, *14766.* Louisiana, Florida.

73. **Ocellularia subtilis** (Tuck.) comb. nov.

Thelotrema subtile Tuck. Am. Journ. Sci. **25**: 426. 1858.

On bark, Caleta Cocodrilos, *15280.* Eastern United States from New England to Texas. Also Ireland, Japan, Australasia.

74. **Leptotrema polyporum** sp. nov.

Thallus crustaceus uniformis indeterminatus crassus (crassitudine ad 0.5 mm.) undulatus desquamescens, superne continuus rugulosus olivaceus aut glauco-olivaceus opacus. Apothecia numerosissima thallo omnino immersa aut rarius verruculas minutas leviter convexas formantia, ostiolo minutissime (0.07–0.12 mm. late) punctiforme rotundato, margine ostiolare integro, thallo concolore aut paullo pallidiore, de supra disco non perspicuo. Intra omnino decolorata. Columella nulla. Asci 8-spori. Sporae fuscae ellipsoideae murali-divisae 4- (rarius 6-) loculares loculis mediis divisis, 14–16 x 6–8 μ.

On bark, Sierra de los Caballos, near Nueva Gerona, collected by O. E. Jennings, May 12, 1910, *229a* (type). Also Florida, without exact locality, collected by Miss Wilson, in Herb. Tuckerman, under the manuscript name *Thelotrema polyporum.*

This species is evidently related to *Leptotrema Wightii* (Taylor) Muell. Arg., but differs in having the ostioles less than half as large, but much more numerous and crowded; the spores are distinctly narrower than in *L. Wightii.*

75. **Leptotrema simplex** (Tuck.) comb. nov.

Thelotrema simplex Tuck. Proc. Am. Acad. Arts and Sci. 6: 271. 1864.

On bark, Rocky Point, Ensenada de Siguanea, *15414*. Cuba.

76. LEPTOTREMA WIGHTII (Taylor) Muell. Arg. On rocks, Cerros de San Juan, *15500*.

77. GYROSTOMUM SCYPHULIFERUM (Ach.) Fr. On *Eugenia*, Sierra de los Caballos, *15140*.

78. LECIDEA BRUJERIANA (Schaer.) Nyl. On rock, San Juan, *15506*.

79. LECIDEA PIPERIS (Spreng.) Nyl. On *Oxandra*, Sierra de las Casas, *15759*.

80. LECIDEA PYRRHOMELAENA Tuck. On sandstone, Sierras de las Tunas, *15520*. This material has been compared with the type specimen which grew on bark in Cuba, where it was collected by Charles Wright. It is a very well-marked species.

81. **Bacidia microphyllina** (Tuck.) comb. nov.

Lecidea microphyllina Tuck. Proc. Am. Acad. Arts and Sci. 6: 278. 1864.

On bark, Sierras de las Tunas, *15512;* on *Amyris elemifer*, Sierra de las Casas, *15765*. Cuba.

82. **Bilimbia Sprucei** (Muell. Arg.) comb. nov.

Patellaria Sprucei Muell. Arg. Flora 64: 228. 1881.

On leaves of *Jambos*, Sierra de las Casas, *15768a;* on leaves of *Hirtella*, La Cunagua, *14593*. Brazil.

83. BOMBYLIOSPORA DOMINGENSIS (Pers.) Zahlbr. On royal palm, Cerro de la Jia, *15213;* San Juan, *15586a;* on rocks (!), Cerros de San Juan, *15499;* on *Amyris elemifera*, Sierra de las Casas, *15762*.

84. **Phyllopsora cryptocarpa** sp. nov.

Thallus granulosus, e granulis minutissimis isidioideo-confluentibus concatenatisve constants, haud squamulosus, crassus (crassitu-

dine ad 0.5 mm.) arcte adnatus areolato-rimosus vel diffractus, umbrinus. Apothecia minuta, 0.2–0.4 mm. lata, numerosa dispersa aut approximata sessilia vel adpressa rotundata regularia, disco plano rufo-badio aut atro-castaneo, margine proprio concolore aut paullo pallidiore integro primum crassiusculo dein tenuiore autem persistente, margine thallino nullo; epithecio et hypothecio badio, hymenio fulvo. Asci 8-spori. Sporae incolores ellipsoideae simplices, 10–12 x 4 μ.

On rotten wood, San Juan, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, March 15, 17, 1916, *15588* (type).

This species is related to *Phyllopsora furfuracea* (Pers.) Zahlbr. and still more closely to **Phyllopsora isidiotyla** (Wainio) comb. nov. (*Lecidea isidiotyla* Wainio Lich. Brés. **2**: 49. 1890), but differs from all other species of the genus in the minute, inconspicuous apothecia.

85. PHYLLOPSORA FURFURACEA (Pers.) Zahlbr. On *Calyptrogyne,* La Cunagua, *14596.*

86. PHYLLOPSORA PARVIFOLIA (Pers.) Muell. Arg. On royal palm, San Juan, *15586.*

87. CLADONIA BEAUMONTII (Tuck.) Wainio. On white sand, vicinity of Los Indios, *14196.* North Carolina, Alabama.

88. CLADONIA DIVARICATA Nyl. On white sand, vicinity of Los Indios, *14254.* Brazil.

89. CLADONIA MEDUSINA (Bory.) Nyl. On white sand, vicinity of Los Indios, *14195.* Brazil, tropical Africa.

90. CLADONIA UNCIALIS (L.) Web. On white sand, vicinity of Los Indios, *14255.* This is a peculiar habitat form, with inflated, subsimple podetia, 40–70 mm. high and 5–10 mm. thick.

91. PYRENOPSIS PHAEOCOCCA Tuck. On granitic rock, vicinity of Siguanea, *14392.* New England, North Carolina.

92. **Anema bullata** sp. nov.

Thallus squamaeformis, e squamis bullatis subglobosis aut rarius irregularibus haud lobatis 1–2 mm. latis, ad 1 mm. altit., umbilicato-adfixis contiguis aut partim dispersis, umbrino-olivaceus nitidulus,

sicco cartilagineo madefacto subgelatinoso; intra omnino pseudoparenchymaticus, strato exteriore crebre contexto cellulis 4–6 μ latis, parte interiore paullo laxiore. Gonidia gloeocapsoidea cellulis 6–11 μ diam. in glomerulosas circa 14–20 μ diam. consociatis, tegumento gelatinoso fuscoluteo. Apothecia minuta omnino immersa primum endocarpea margine connivente ostiolo punctiforme, indicata, demum paullo aperta disco badio. Asci 8-spori. Sporae incolores oblongo-ellipsoideae simplices, 10–12 x 6–7 μ. Spermagonia pyriformia thallo immerso, ostiolo haud perspicuo. Spermatia ovoidea minutissima.

On limestone, Key View Hill, Vivijagua, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 28–29, 1916, *15089* (type).

This species has an external resemblance to *Omphalaria pyrenoides* Nyl., but differs in the color and in the internal structure of the thallus.

93. **Thyrea cubana** (Tuck.) comb. nov.

Omphalaria cubana Tuck. Genera Lichenum 83. 1872.

On limestone, Rocky Point, Ensenada de Siguanea, *15425*. Cuba.

94. THYREA GIRARDI (Dur. & Mont.) Bagl. & Car. On limestone, Rocky Point, Ensenada de Siguanea, *15424*. Alabama; also Europe.

The specimens are sterile and the determination is not certain, but they agree with material in the Tuckerman Herbarium labelled "probably young *Omphalaria Girardi*."

95. DICHODIUM BYRSINUM (Ach.) Nyl. On royal palm, La Cunagua, *14603*.

96. LEPTOGIUM CHLOROMELUM (Sw.) Nyl. On *Annona palustris*, vicinity of Jucaro, *14644*.

LEPTOGIUM CHLOROMELUM STELLANS Tuck. On *Bucida spinosa*, vicinity of Siguanea, *15391*; on *Conocarpus*, Rocky Point, Ensenada de Siguanea, *15416*; on bark, vicinity of Columbia, *15711*.

97. LEPTOGIUM TREMELLOIDES CAESIUM (Ach.) Hue. On *Thrinax*, Rocky Point, Ensenada de Siguanea, *15418*; on royal palm, San Juan, *15484*, *15485*.

98. COCCOCARPIA PELLITA GENUINA Muell. Arg. On *Peltophorum,* vicinity of Siguanea, *14382.*

COCCOCARPIA PELLITA PARMELIOIDES (Hook.) Muell. Arg. On orange, La Cunagua, *14587;* on royal palm, San Juan, *15585.*

COCCOCARPIA PELLITA SMARAGDINA (Pers.) Muell. Arg. On royal palm, San Juan, *15589.*

COCCOCARPIA PELLITA TENUIOR (Nyl.) Muell. Arg. On royal palm, San Juan, *15486.*

99. PERTUSARIA VELATA (Turn.) Nyl. On *Curatella,* Cerro de la Jia, *15209.*

100. LECANORA CALCAREA CONTORTA Fr. On sandstone, La Cunagua, *14580;* on rock, vicinity of Siguanea, *15238.*

101. LECANORA CINEREA (L.) Sommerf. On schist, Sierra de la Cañada, *14438.*

Spores smaller than in northern material, but the same thing is true of tropical specimens of *Buellia parasema.*

102. LECANORA CINEREOCARNEA (Eschw.) Wainio. On *Coccothrinax,* La Cañada, *14424* in part; on *Lysiloma,* Vivijagua, *15040;* on *Coccolobis,* Vivijagua, *15643a;* on bark, Rocky Point, Ensenada de Siguanea, *15407.*

103. LECANORA PROSECHA Ach. On limonite conglomerate, Rio de las Casas, *15660, 15661.* Distribution uncertain, but definitely recorded from the islands of Dominica and St. Vincent, in the West Indies, and from Colombia, South America. The specimens agree well with the detailed description given by Wainio in the Jour. Bot. 34: 35. 1896.

104. LECANORA VARIA (Ehrh.) Nyl. On *Coccothrinax,* La Cañada, *14424* in part.

105. HAEMATOMMA PUNICEUM LEPRARIOIDES Wainio. On *Purdiaea,* vicinity of Los Indos, *14230.*

106. PARMELIA ABSTRUSA Wainio. On quartz rocks, La Cañada, *14435;* Las Tunas, *15519;* vicinity of Siguanea, *15239.* Brazil.

107. PARMELIA LATISSIMA CRISTIFERA (Taylor) Hue. On orange, La Cunagua, *14586;* on *Conocarpus,* Rocky Point, Ensenada de Siguanea, *15415*.

108. PARMELIA PLURIFORMIS Nyl. On schist, Sierra de la Cañada, *14436;* vicinity of Siguanea, *15237*. Brazil.

109. PARMELIA STENOPHYLLOIDES (Muell. Arg.) Wainio. On rocks, vicinity of Siguanea, *14391, 14393*. Brazil, Paraguay.

110. RAMALINA MONTAGNEI DeNot. On *Pseudocarpidium,* Vivijagua, *15075*.

111. RAMALINA USNEOIDES (Ach.) Fr. On *Bucida,* Coe's Camp, Ensenada de Siguanea, *14835;* vicinity of Columbia, *15717*.

112. USNEA FLORIDA STRIGOSA Ach. On branches, Siguanea, *14950*.

113. USNEA IMPLICITA (Stirton) R. H. Howe Mycologia **6**: 262. 1914.

Eumitria implicita Stirton Scot. Nat. **6**: 100. 1881.

On *Bucida spinosa,* vicinity of Columbia, *15716*. Jamaica, Porto Rico.

The material is softer and more pendulous than usual.

114. **Blastenia Brittonii** Zahlbr. ms. in Herb. New York Bot. Gard.

Thallus epilithicus crustaceus uniformis aut ambitu subradiato-lobulatus effiguratusque, centro rimoso-areolatus areolis leviter convexis contiguis aut dispersis hypothallo nigro, crassiusculus, albidus vel albido-cinerascens. Apothecia ad 0–6 mm. lata regularia sessilia superficialia dispersa, primum fusca dein omnino nigra opaca, disco plano, margine proprio crassiusculo et prominente aut tenuiore persistente integro aut crenulato, margine thallino nullo; excipulo nigro, epithecio badio, hymenio et hypothecio incolore. Asci 8-spori. Sporae incolores ellipsoideae polari-biloculares membrana inaequaliter incrassato loculis poro confluentibus, 12–14 x 6–7 μ.

On rock, Culebra Island near Porto Rico, collected by N. L. Britton and W. M. Wheeler, March 3–12, 1906, *260* (type). On

sandstone, Loma La Daguilla, Isle of Pines, *15179;* Cerro de la Jia, *15232;* on rocks, Cerros de San Juan, *15502;* on limestone, Cerros de Guanabana, *15640.*

The thalline characters are similar to those of *Blastenia phaea* (Tuck.) Muell. Arg. and of *Blastenia nigrocincta* Riddle. But the blackening apothecia with margin and disk concolorous are distinctive.

115. BLASTENIA FORSTROEMIANA (Fr.) Muell. Arg. On limestone, Cerro San Juan del Mar, Columbia, *14681;* Cerros de Vivijagua, *15056, 15057.* The type locality for this species is the "West Indies," but without the definite locality being specified.

116. BLASTENIA NIGROCINCTA Riddle Mem. Brooklyn Bot. Gard. 1: 113. 1918. On limestone, Key View Hill, Vivijagua, *15088.* Porto Rico, Virgin Islands. Also on bark (!), Palm Barren, City of Santa Clara, Cuba, N. L. Britton, Elizabeth G. Britton, and Percy Wilson, March 29–31, 1910, *6209.*

117. BLASTENIA PHAEA (Tuck.) Muell. Arg. On rocks, Cerros de San Juan, *14997, 14999, 15503, 15505;* on limestone, Cerro San Juan del Mar, Columbia, *14682;* on limestone, Vivijagua, *15051, 15087;* on sandstone, Loma La Daguilla, *15178, 15180.* Cuba.

The original material of this species was somewhat scanty, and the description given by Tuckerman is brief, so that it seems worth while to give an amplified description on the basis of the full material from the Isle of Pines, especially as the species appears to be a variable one.

Thallus crustose, indeterminate, effuse, the margin not at all effigurate, of medium thickness, whitish or glaucous, or occasionally smoky, continuous and irregularly rimulose, or more often definitely rimose-areolate, the areoles flat, undulate, or convex, usually contiguous, sometimes scattered, on a black hypothallus which may be well developed or evanescent. Apothecia 0.4–0.6 mm. in diameter, when young with fulvous or badious disk and a pale, thick, entrie or flexuous margin, later the persistent margin becoming concolorous with the disk, and both darken to a deep

brown, but never to black. Epithecium fulvous to badious, lamina otherwise colorless. Spores colorless, oblong-ellipsoid, polar-bilocular, the cells rarely connected with a tube, very uniform in size, about 10 x 5 μ.

118. **Buellia Brittoniae** sp. nov.

Thallus epilithicus crustaceus arcte adnatus determinatus effiguratus, ambitu pulchre radiato-laciniatus isabellinus nitidulus, laciniis 0.2–0.4 mm. latis contiguis sublinearibus aut partim cuneatis leviter convexis, centro rimoso-areolatus vel diffractus fuligineus, areolis convexis contiguis, sat tenuis crassitudine vix 0.2 mm., intus albissimus; KOH non reagens. Hypothallus nigricans evanescens. Apothecia 0.3–0.5 mm. lata, sessilia aut adpressa haud immersa, dispersa aut paullo approximata rotundata regularia omnino fusco-nigra aut nigra opaca, disco scabroso primum planiusculo margine tenuissimo dein mox convexo emarginato; epithecio crasso nigro, hypothecio fusco. Asci 8-spori. Sporae fuscae oblongo-ellipsoideae biloculares haud placodiomorphae membrana aequaliter tenue, 11–14 x 4–5 μ.

On sandstone, La Cañada, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 16, 1916, *14579* (type). Also on quartz, Las Tunas, *15518*.

This is a well-marked and very distinct species, and can not be readily confused with any other. Its thalline characters are suggestive of those of *Rinodina thysanota* Tuck., but the apothecia and spores are entirely typical of the genus *Buellia*. I take pleasure in naming this—one of the finest of the new species from the Isle of Pines—in honor of Mrs. Elizabeth G. Britton.

119. **Buellia flavogranulosa** sp. nov.

Thallus epilithicus crustaceus effusus indeterminatus flavus, granularis, granulis minutis, 0.1–0.3 mm. latis, rotundatis aut paullo lobatis subsquamuliformibus late dispersis; KOH non reagens. Hypothallus nullus. Apothecia 0.5–0.7 mm. lata dispersa sessilia aut sat elevata rotundata regularia, disco primum plano demum leviter convexo, nigro nudo nitidulo, margine proprio nigro tenue persistente integro, margine thallino nullo; epithecio et hypothecio nigricante, hymenio decolore. Asci 8-spori. Sporae fuscae ellipsoideae biloculares placodiomorphae loculis poro haud confluentibus, 16–18 x 8 μ.

On sandstone, La Cunagua, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 19, 1916, *14578* (type).

This species differs from *Buellia prospersa* (Nyl.) Riddle, which has spores of the same type, in having the thallus in the form of scattered granules of an intense-yellow color. From other rock-inhabiting species of *Buellia* with yellow thallus, this differs in the polar-bilocular spores.

120. BUELLIA PARASEMA (Ach.) Th. Fr. On *Conocarpus*, Siguanea, *14940*.

121. BUELLIA SANGUINARIELLA (Nyl.) Wainio. On *Colpothrinax*, San Pedro, *14827*. Bahamas, Cuba, Colombia.

122. BUELLIA SUBDISCIFORMIS (Leight.) Wainio. On *Cocothrinax*, La Cañada, *14423a, 14426*; on *Colpothrinax*, San Pedro, *14549, 14550*; on *Lysiloma*, Vivijagua, *15034*; on *Oxandra*, Sierra de los Caballos, *15145*.

123. **Buellia subdispersula** sp. nov.

Thallus epilithicus crustaceus effusus indeterminatus, cinereus aut cinereo-stramineus, areolatus areolis minutis ad 0.5 mm. latis contiguis aut dispersis pulvinatis rugulosis vel irregularibus partim squamuliformibus; KOH haud reagens. Hypothallus albidus evanescens. Apothecia 0.3–0.5 mm. lata, dispersa aut approximata, sessilia rarius paullo immersa, rotundata regularia, disco nigra scabro opaco, primum plano margine proprio tenue nigro, dein convexo emarginato; epithecio et hypothecio fusco-nigricante. Asci 8-spori. Sporae fuscae ellipsoideae aut oblongae, biloculares placodiomorphae, membrana inaequaliter incrassato luminibus depresso-cordatis approximatis, 14–20 x 7–9 μ.

On sandstone, La Cunagua, collected by N. L. Britton, Elizabeth G. Britton, and Percy Wilson, Feb. 19, 1916, *14577* (type).

In the thalline characters this is related to *Buellia dispersula* Muell. Arg., but it differs in the convex, emarginate apothecia, and in having spores of the type found in the section Mischoblastia of the genus Rinodina.

124. PYXINE COCOES (Sw.) Nyl. On *Pseudocarpidium*, Vivijagua, *15080*.

125. PHYSCIA CRISPA (Pers.) Nyl. On *Sideroxylon*, Sierra de los Caballos, *15144*; on *Thrinax*, Rocky Point, Ensenada de Siguanea, *15422*.

126. PHYSCIA INTEGRATA Nyl. On *Tabebuia*, Vivijagua, *15598;* on bark, Mt. Diablo above Vivijagua, *124a.*

PHYSCIA INTEGRATA SOREDIOSA Wainio. On *Curatella*, Cerro de la Jia, *15208.*

127. PHYSCIA PICTA (Sw.) Nyl. On *Cordia collococca*, Cerro San Juan del Mar, Columbia, *14670.*

ANTHRACNOSE OF THE BOSTON FERN[1]

JAMES A. FARIS

(WITH PLATES 8 AND 9)

The Boston fern (*Nephrolepis exaltata* (L.) Schott.) is a house plant very widely grown for ornamental purposes, and because of its merited popularity as an indoor plant its culture constitutes one of the valuable branches of the florist trade. The unusual freedom from disease of these ferns under indoor conditions contributes largely, no doubt, to their wide cultivation.

In the extensive fern collection of Dr. R. C. Benedict at the Brooklyn Botanic Garden, where he is experimenting upon the origin of new varieties of *Nephrolepis* (2, 3), some plants have become attacked by an anthracnose disease. This condition was first noticed by Dr. Benedict in 1919 and seemed to be confined to certain sporeling strains then under observation. Although serious injury was confined to a few individuals, these infected plants continued to have diseased fronds season after season. A planting of sporelings set out for bed-culture in the fall of 1921 were so seriously diseased that they made little growth, each new leaf being killed at its growing tip soon after it began to unroll. Such plants showed a mass of dead and withered stumps of fronds with here and there a straggling leaf which had escaped death, but always showing the anthracnose lesions.

SYMPTOMS OF THE DISEASE

The disease first appears upon the growing tips of the fronds and upon other succulent leaf-tissue which has not become hardened. The lower parts of the fronds sometimes show typical anthracnose lesions; but the writer's observations have been that the infection in these cases has always taken place before the tissue has become hardened and woody.

The first appearance of the disease is indicated by a slight browning of the infected tissue. This becomes apparent in inoculations

[1] Brooklyn Botanic Garden Contributions No. 29.

from pure cultures about forty-eight hours after spraying the inoculum upon uninjured, vigorously growing fronds. The brown spotting involves only a few of the epidermal cells at first, but rapidly spreads longitudinally and around the midrib and petiole of the frond, finally involving the young pinnae. Attacked tissues shrink rapidly, presenting an appearance such as is shown in figure 1 at the end of the fifth day after inoculation.

When the plant is kept under humid conditions, small white patches begin to appear over the surface of the brownish lesions within a few days, but these white masses of conidia do not become apparent except under conditions of high humidity. Seldom does the canker appear over the entire frond, but two or three separate lesions on the same frond are not uncommon. The infection of the older fronds is limited to the young parenchymatous tissues near the apex of the leaves. A considerable area of the leaf may become infected in this way, as is shown in figure 2, which is a photograph of four older leaves inoculated with pure cultures of the organism at varying distances behind the unrolling tip. The inoculation was made at one inch behind the tip in *A*, two inches behind in *B*, three inches behind in *C*, and four inches behind in *D*. Inoculations farther back upon the maturer leaves gave no infection.

In exceptional cases, where the lower part is attacked, the unrolling tip may continue growth for a time. It is short-lived, however, and eventually withers, shrivels, turns brown and finally almost black. Attacks on older tissues by the fungus may result in a limited canker being produced. As a whole, susceptible ferns present a blighted, sickly appearance with their numerous dead fronds far outnumbering the isolated, partially diseased ones which have been able to develop a few pinnae.

THE CAUSAL ORGANISM

Isolation.—Small pieces of diseased fronds about ½ cm. in length were immersed for five minutes in corrosive sublimate solution (1 : 1000), rinsed in distilled water, and then plated in potato agar slightly acidulated with a 5 per cent. solution of lactic acid. These plates were kept in the incubator at 20° C. Within forty-eight hours mycelium began to grow out from the pieces of host

tissue. By the fourth day appressoria were abundant, and at the end of a week masses of spores formed within the surface mat of mycelium. A few such cultures were pure and from these, conidia were transferred to fresh dishes. Within one month perithecia began to form, and by the end of the seventh week the plates were literally covered with them. (Fig. 3.)

The growth of the fungus.—The fungus grows slowly on potato agar and the extension of the colony is rather limited. It grows more rapidly on corn-meal agar made up by the formula given by Shear and Wood (4). On corn-meal agar the plates were covered and perithecia formed within five weeks. When two or more colonies are growing in the same dish the mycelia do not intermingle, but check growth as the edges of the colonies approach each other, causing a surface piling up and leaving a definite margin between the colonies. (See fig. 3.)

There is no noticeable increase in the number of perithecia formed at the margins of these colonies, however.

MORPHOLOGY AND PHYSIOLOGY OF THE FUNGUS

The imperfect stage.—In the imperfect stage this fungus is of the typical *Colletotrichum* type, producing setae around the acervulus. The one-celled spores are produced abnormally in acervuli, both in culture-media and on the diseased fronds. There is a gelatinous matrix around the spores which holds them together when dry, but dissolves readily in water, permitting their spread as in the case of the anthracnose of the bean (1). The acervuli on the host are innate, erumpent, discoid, surrounded by long, black setae six to twelve in number; conidia tetrete to fusoid, 4–6½ x 12–18 μ; conidiophores rather short, straight, seldom curved, usually bluntly rounded at the tips. Germination usually begins by the formation of a septum in the conidium, followed by the protrusion of a germ tube from either the side or end. This tube usually grows a short distance and then forms an appressorium from which further growth may take place. These appressoria are subglobose, flattened on one side, and have dark-colored thick walls containing dense granular cytoplasm. Typical conidia from artificially infected fronds of the Boston fern are shown in figure 4. Setae at the edge of the acervulus are also shown.

The ascogenous stage.—The ascogenous stage has never been found upon diseased ferns by the writer. The perithecia in cultures assume a variety of forms according to whether they are produced in groups or singly (fig. 5). When produced singly they are membranous, dark-brown to almost black, with a lighter-colored beak at the apex, flask-shaped, sparingly hairy, and immersed in the medium. The asci are sessile, fusoid, 8–12 x 68–120 μ. Spores hyaline, granular, fusiform, 1-celled, and 4–6 x 13–16 μ. Paraphyses none. (See fig. 6.)

The ascospores germinate readily in a manner very similar to the conidia by producing one or more germ tubes which develop appressoria and mycelium.

NAME OF THE ORGANISM

The spore measurements for both conidia and ascospores average rather low for species of *Glomerella* as given by Shear and Wood (4), but are well within the limits of those given for *Glomerella cingulata*.

In order to determine whether the organism in hand would infect hosts readily attacked by *G. cingulata*, transfers from pure cultures were made in the first case to the fruit of the apple. This test was repeated eight times upon as many different varieties of apples and in no case did any infection occur.

Similar tests were also tried upon the green pods of the bean, *Phaseolus vulgaris*, and upon the fruits of the banana and cucumber, with the like result that no infection occurred. While no inoculations were made upon cotton, this fungus would seem to differ from *Glomerella gossypii*, which is described as having paraphyses.

The failure of cross-inoculation experiments, together with the growth characteristics of this organism, would seem to justify according it specific rank and it is tentatively named **Glomerella Nephrolepis** sp. nov.

RELATION OF THE FUNGUS TO THE HOST

When either ascospores or conidia germinate upon a susceptible plant of the Boston fern, they produce appressoria and in turn fine hyphae which penetrate the cuticular and subcuticular layers and

produce a vesicle from which branches arise and extend into the host tissue. The invading hyphae enter the host cells, causing their collapse. The growth of the hyphae through the young tender tissue is very rapid and can be followed by the browning of the host cells soon after attacked. The walls collapse and the lesions become conspicuous within a few days, as is well shown in figure 1.

At about the time the cankered areas form the mycelium begins to develop abundantly in the epidermal cells and those just beneath, forming a stroma of closely crowded and septate hyphae. The host cells at this time are badly disorganized and the individual cells are difficult to observe. From the pseudoparenchymatous tissue thus formed arise short conidiophores, at the apex of which are borne the bluntly rounded conidia. These are produced in such abundance that they soon rupture the cuticle and are freed. (See fig. 4.) The lesions produce the acervuli at the center first and farther out as the canker enlarges. Long, brown, 4–5-septate setae are produced around the margin of the acervulus, both on the host and in cultures. They are almost the same diameter throughout, tapering bluntly to a point at the free end. The setae are few (6–12) in number and on the host about 6 μ in diameter and 120–200 μ in length.

PROOF OF PARASITISM

From pure cultures secured as heretofore described both conidia and ascospore subcultures were made. Spores from both types of cultures were sprayed upon healthy fern plants, incubated under bell jars, and typical lesions were produced. From these lesions isolations were again made and the cycle repeated five times. In every case typical diseased fronds were produced, and cultures made from all cycles have consistently shown the same cultural characteristics.

VARIATIONS IN SUSCEPTIBILITY

In regard to differences exhibited by the various strains of the Boston fern to the attack of the fungus, Dr. Benedict, in a letter to the writer, makes the following note: "In one number, 315, this blighting affected a portion of the leaves regularly. The variety

was tested to see whether perfect leaves might be produced under the best conditions, but without success. Grown in poor conditions, almost all the leaves would stop growing when about one third the length typical for the form had been reached. None of the other sporelings tested out at the same time showed the same defect. Later, in another batch of plants of the same sowing, a similar diseased condition was noted in at least three numbers, 75–5, 75–11, 75–14. . . . All except the three numbers mentioned above made vigorous, healthy growth, but these showed the leaf-blighting both in stock cultures and in those in the pots. There are indications of occasional blighting of single leaves in other numbers, but these four above are the ones which show a continuous affected condition."

ECOLOGIC ASPECTS AND CONTROL

The spread and maintenance of the disease are fostered by a crowding of the plants on the benches and in the propagating houses, by overhead watering, where the water remains on the leaves for long periods of time, and by high humidity and temperature. Spread of the disease in the greenhouse is primarily through close planting or crowding and watering.

Tests, where slightly infected plants were pruned of all diseased leaves, the soil covered with a coating of sand and water applied only to the soil, have demonstrated that slightly susceptible forms may be rid of the disease by these measures.

The following control measures have been found effective:

1. Selection of resistant forms. Variation in susceptibility points the way to control by this means.

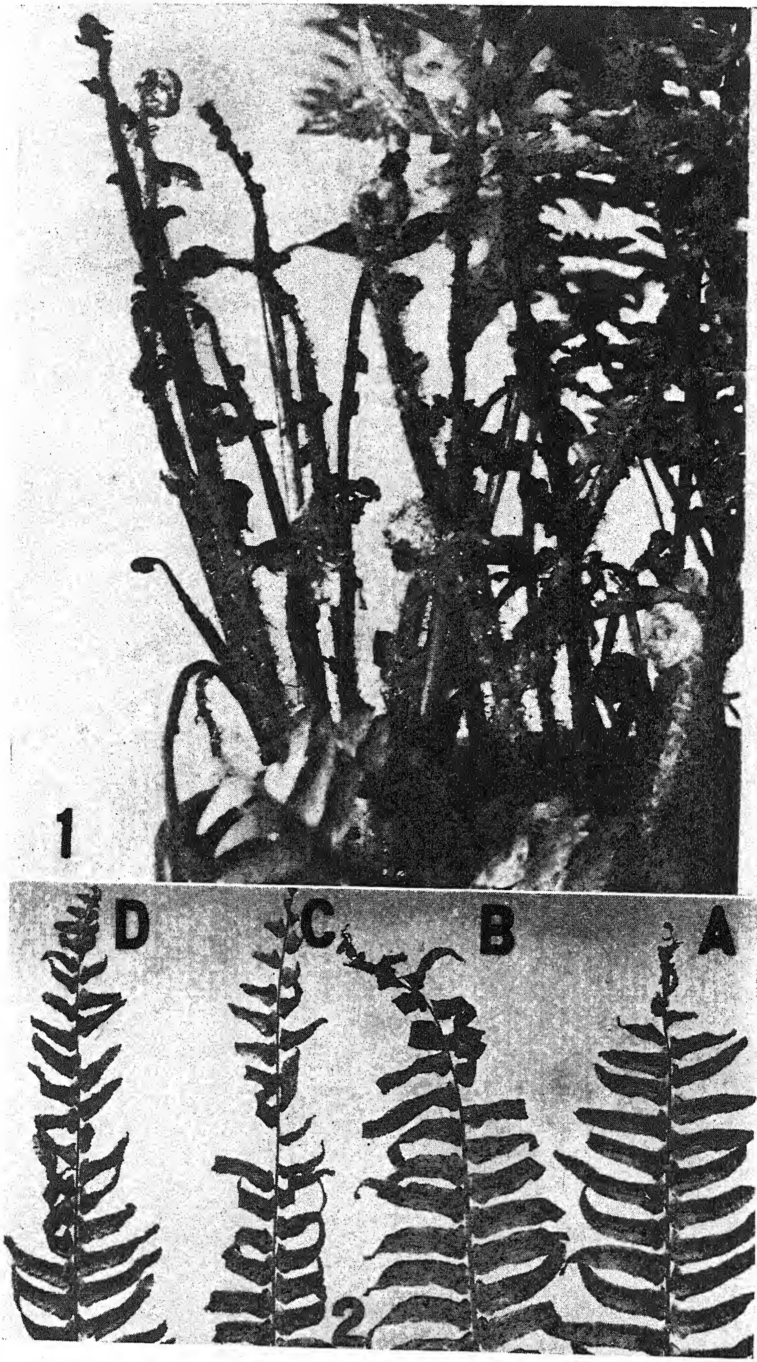
2. Proper aëration of the greenhouse to keep a low relative humidity.

3. Watering the soil in the pots and benches, care being taken to dry the leaves after washing them.

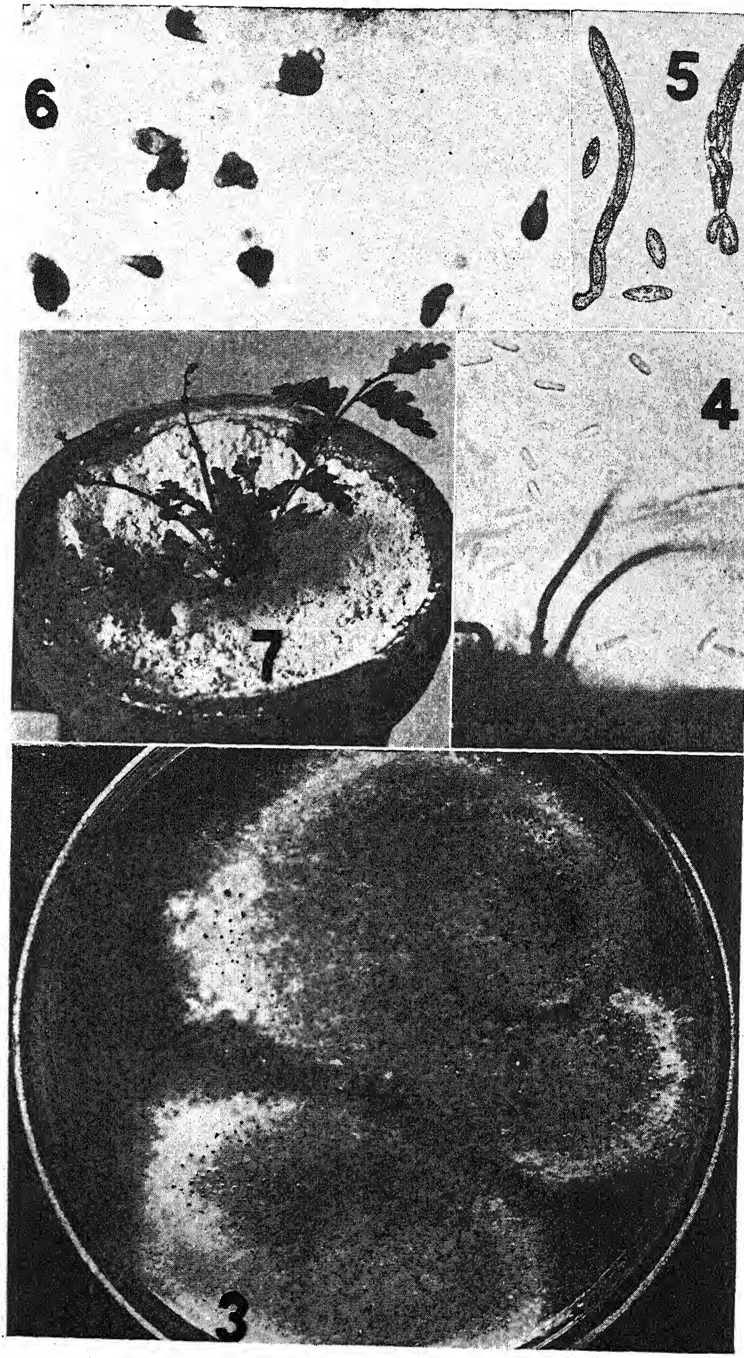
4. Removal of all infected tissue as it appears and destruction of badly diseased plants.

The writer is indebted to Dr. R. C. Benedict for an abundant supply of host material.

BROOKLYN BOTANIC GARDEN.



BOSTON FERN INOCULATED WITH GLOMERELLA NEPHROLEPSIS FARIS



CULTURES AND SPORES OF GLOMERELLA NEPHROLEPIS FARIS

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EXPLANATION OF PLATES

PLATE 8

Fig. 1. Young fronds of Boston fern five days after inoculation from pure cultures of the anthracnose organism. Reduced.

Fig. 2. The tips of four fronds inoculated at varying distances from the terminal growing point. Reduced.

A. Inoculated 1 inch behind the tip.
B. Inoculated 2 inches behind the tip.
C. Inoculated 3 inches behind the tip.
D. Inoculated 4 inches behind the tip.

PLATE 9

Fig. 3. Petri dish cultures seven weeks old showing growth habits of the anthracnose fungus upon potato agar.

Fig. 4. Microphotograph of conidia and setae of the *Colletotrichum* stage.

Fig. 5. Camera lucida drawing of asci and ascospores. × 375.

Fig. 6. Microphotograph of various forms of perithecia produced in agar cultures.

Fig. 7. Typical attack on a young sporeling. Normal size.

NOTES AND BRIEF ARTICLES

[Unsigned notes are by the editor]

Dr. C. G. Lloyd called at the Garden late in August on his way to Kew Gardens, England, to examine type material in certain groups of fungi. He expects to visit France and Italy also before he returns.

Commercial plantings of China aster in New York State have been severely attacked by a new species of *Septoria,* according to W. O. Gloyer, who describes the fungus in *Phytopathology* as *S. Callistephi.*

Dr. Montemartini, of the Cryptogamic Laboratory, Pavia, Italy, writes me that Saccardo's "Sylloge Fungorum" will be continued, and that he will be glad to receive for this publication any mycological information published since 1917.

Phytopathology for May, 1922, contains a series of papers of the greatest importance on "Insects as Disseminators of Plant Diseases." Various phases of the subject are there discussed by F. V. Rand, E. D. Ball, L. Caesar, and M. W. Gardner.

Dr. James R. Weir, of the Department of Forest Pathology at Washington, D. C., spent from the middle of July to the first of September at the Garden studying the collection of polypores and comparing specimens from his large private collection with authentic material here.

It is interesting to note that it was discovered by R. H. Colley, in making tests of pieces of Sitka spruce and Douglas fir for air-

plane stock, that the effect of *Fomes pinicola, F. Laricis,* and *Polyporus Schweinitzii* on such timber was decidedly more prominent than that of *Trametes Pini.*

The fourth International Phytopathological Conference, on Truck Crop Diseases, met at Seaford, Delaware, August 28, 1922. Three days were spent in studying these diseases in the field—in Delaware, New Jersey, and Pennsylvania—and one day was devoted to inspecting the markets of Philadelphia.

A handsomely illustrated paper on the species of *Lentinus* in the region of the Great Lakes, by the late E. T. Harper, appeared in the *Trans. Wisc. Acad. Sci.* for February, 1922. *Lentinus lepideus, L. tigrinus, L. adhaerens, L. suavissimus, L. cochleatus, L. ursinus, L. vulpinus,* and their relatives are discussed at some length.

In a collection of basidiomycetes brought back from British Guiana last September by Prof. F. L. Stevens, there was a specimen of *Amauroderma subrenatum* Murrill, described and previously known only from British Honduras, where it was collected by Prof. Morton E. Peck.

E. C. Stakman and M. N. Levine have keyed the 37 known biologic forms of *Puccinia graminis Tritici* in a preliminary account of the method employed by them in determining the identity of the forms through their action on certain "differential hosts." (*Tech. Bull. Univ. Minn. Agr. Exp. Sta.* 8: 3–10. July, 1922.)

A new disease of cotton, caused by *Ascochyta Gossipii* Sydow, is discussed by Elliott in Bulletin 178 of the Arkansas Experiment Station. This disease appeared in Arkansas in 1915 and again in 1920, both outbreaks having been preceded by unusual rainfall. It

attacks all parts of the plant above ground, including the bolls, and over-winters on the dead stalks. Rotation of crops is suggested as the most obvious remedy.

Lenzites sepiaria, L. trabea, Trametes serialis, Fomes roseus, Lentinus lepideus, and other fungi causing decay of building timbers are discussed at length by W. H. Snell in Bulletin 1053 of the U. S. Dept. of Agriculture. Studies are reported on the physiological relations of the spores and mycelium of these fungi, with characters of cultures and a key to their identification; also good illustrations and a full bibliography.

The polypores of South Africa were listed, keyed, and described by van der Bijl in the *S. A. Journal of Science* for June, 1922; *Polyporus durbanensis, P. trichiliae, P. ochroporus, P. flexilis, Trametes varians, T. griseo-lilacina, T. Keetii, T. tomentosa,* and *Daedalea Hobbsii* being described as new. The author acknowledges the coöperation of Mr. C. G. Lloyd in this work, and his name appears after a number of species not mentioned in the above list.

A very attractive illustrated bulletin on the Botrytis blight of tulips, by E. F. Hopkins, appeared as Memoir 45 of the Cornell University Experiment Station. The characters of the disease, with the morphology and physiology of *B. Tulipae,* are given in detail. The fungus hibernates on the bulbs and blights the leaves and flowers the following spring. The use of clean stock is recommended, with careful handling, good storage conditions, and the prompt destruction of all diseased plants.

Mycological notes for 1920, by L. O. Overholts in the *Torrey Bulletin* for June, 1922, include discussions and illustrations of *Zythia resinae* (Ehrenb.) Karst., *Biatorella resinae* (Fr.) Mudd., *Pilacre Petersii* B. & Br., *Tulasnella Violae* (Quél.) Boud. & Gal.,

Dacryomyces hyalina Quél., *Stereum radiatum* Peck, *Merulius fugax* Fr., *Solenia fasciculata* (Pers.) Fr., *Polyporus caeruloporus* Peck, *Fomes Bakeri* Murrill, and *Phallogaster saccatus* Morgan. *Polyporus compactus,* a resupinate species, is described as new.

Graff's fifth paper on "Philippine Basidiomycetes" appeared in the *Torrey Bulletin* for August, 1922. *Daedalea subconfragosa* Murrill is said to be synonymous with *D. lurida* Lév.; *Trametes versatilis* Berk. is transferred to *Daedalea; Inonotus Clemensiae* Murrill and *Hapalopilus subrubidus* Murrill are transferred to *Hexagonia; Auricularia reticulata* Fries is transferred to *Gloeoporus,* with *G. conchoides* Mont. as a synonym; and the new genus *Copelandia* Bres., based solely on the presence of cystidia, is re-included in the genus *Panaeolus.*

A severe bacterial disease, which attacks all kinds of bananas in the Dutch East Indies, has been under investigation for several years by E. Gäumann, who calls it the "blood disease." It involves yellowing of the whole leaf-crown and discoloration of the fruit. Internally, the symptoms resemble those due to the so-called Javanese disease. The changes in the fruit are most specific, including a yellowing or browning of the central vascular bundles, extending even to the fruit rind. Transmission takes place from mother plants to younger plants or by way of the air, but the carrying agent has not been identified.

The cytology and life history of the fungus causing the wart disease of potato has been investigated by K. M. Curtis, of the Royal Society of London. His published treatment includes the morphology of the prosorus and sorus; the zygote; the resting sporangium; and a general discussion including the relation of fungus and host plant, the persistence of the organism in the soil from year to year, immunity from wart disease, nuclear reduction, the relation of the fungus to the genus *Pycnochytrium,* and sexu-

ality in the Synchytriaceae. A bibliography is given of about 50 titles representing widely separated regions.

An illustrated article on Philippine Edible Fungi, by O. A. Reinking, appeared in Bulletin 22 of the Philippine Bureau of Forestry, published in the summer of 1922. Species of *Auricularia, Coprinus, Agaricus, Pleurotus, Lepiota, Lycoperdon*, etc., are described and general methods of cooking discussed. It is rather surprising to find four species of *Panaeolus* included as edible. *Volvaria esculenta* Bres. is said to be the most important and common edible gill-fungus found in the Philippines. It is collected wild and is also cultivated in the abaka and rice districts on decaying trash. Its flavor is strong and agreeable and it keeps well in a dried condition.

An interesting museum object made partly of the sporophore of a bracket fungus (*Elfvingia tornata*) was presented to the Garden by Dr. Tanaka, one of the associate editors of *Mycologia*, when he passed through New York late in July on his way to Japan. The sporophore was cut and hollowed out to form a pouch for tobacco, and attached to it by a cord was a pipe-case made of veneered wood. This species of bracket fungus is as common in the Orient as the artists' sketching fungus (*Elfvingia megaloma*) is in America, and, according to Dr. Tanaka, is abundantly used for the manufacture of small boxes, trays, etc., in the prefecture of Ehime on the Shikoku Island, where the museum object mentioned above was purchased.

Mr. Perley Spaulding has summarized in a recent bulletin the extensive investigations made on blister rust of white pine, and concludes that the most practical method of control is to destroy all the Ribes within 300 yards of white pine trees. It appears that this disease is of Asiatic origin, where its original host plant is thought to have been *Pinus Cembra*. It was probably introduced into this country from Europe on young pine trees late in the nine-

teenth century. The life history of the fungus on pines and on species of Ribes is described at length, and the known and suspected host species of Pinus and Ribes are enumerated. The organism is said to over-winter on pines and under some conditions on Ribes also.

Experiments with fungi attacking paints have been conducted by C. M. Haenseler, of the N. J. Exp. Station, who reports *Dematium pullulans,* several species of *Cladosporium,* two species of *Phoma,* and an unidentified fungus causing discoloration on painted surfaces, with *Cladosporium* and *Aspergillus* causing considerable injury to varnished surfaces. These fungi were unable to derive their full nourishment from the oil in the paint, and it is believed that they obtain some of it from foreign matter which happens to be on the paint. Panel tests showed that, next to lithopone, pure white lead was the most subject to attack, while zinc oxide and mixed paints showed only occasional colonies. Antiseptics and fungicides added directly to paints were not especially effective.

A bulletin by C. O. Smith on the infection of, and resistance to, walnut blight in California states that this serious bacterial disease of the Persian walnut is probably transmitted only through the old blight lesions in which the organism remains alive during the dormant period, coming to the surface under favorable conditions. It may come to the surface of both leaf-buds and catkin-buds before spring growth begins, though the actual significance of such occurrence has not been fully established. Infection may not occur before the new growth appears in spring. Fog, dew, and late rains appear to be important agents in the spread of the disease, but insects and pollen may carry the infection to some extent.

A paper on "Slugs as Mycophagists," by Buller in the *Transactions of the British Mycological Society* for 1922, contains the following conclusions:

"The successful experiments with *Phallus impudicus, Russula heterophylla,* and *R. nigricans,* described above, clearly show that

the fruit-bodies of these fungi, under certain conditions in the open, attract *Limax maximus* from a distance of at least 10 to 21 ft.

"Having regard to the well-known short-sightedness of slugs, to the fact that slugs find their food at night, and to the sensitiveness of *Limax maximus* to mustard gas when diluted to one part in ten million, my observations and experiments led me to suppose that fungus-eating slugs react at a distance to the odors given off by fleshy fungi, and that in woods and gardens they find the fungi upon which they feed by their sense of smell."

Several members and friends of the Yama Farms Mycological Club, of which Dr. Murrill is president, spent nearly a week in the Catskills early in August studying the fungi in particular and other plants incidentally. The days were devoted to collecting and making field observations, while the evenings were given over to addresses and discussions on "Fungi," "Edible and Poisonous Mushrooms," "Wild Flowers," "Trees," etc. Invitation addresses were given by Dr. F. B. Turck on "Fundamental Biological Principles," by Mr. Edsell on "Water Power," and by Miss Phillips on "The Federated Clubs of American Working Women." Mr. H. I. Miller, chairman of the executive committee—a most genial host and efficient manager—presided at the meetings. Dr. H. D. House, State botanist and one of the officers of the club, carried back to the herbarium at Albany a number of rare and interesting specimens. Mr. John A. Kingsbury, former commissioner of charities in New York, was one of the guests and soon afterwards became an active member.

Plant nomenclature is discussed by J. H. Barnhart in the *Journal of Botany* for September, 1922. In considering the revocation of Article 36, which requires Latin diagnoses, he says in part:

Today nearly every botanist can read with little difficulty English, French, and German, and can write at least one of those languages. As far as descriptive botany is concerned, one who can read these three need have little difficulty with any other Romanic or Teutonic language, and this extends the scope of his reading to

Swedish, Norwegian, Danish, Dutch, Flemish, Portuguese, Spanish, Italian, and Latin. These two groups, the Romanic and Teutonic languages, with many words in common, and not more than two or three for any plant structure or character, include the mother-tongues of nearly all the plant taxonomists of to-day, and some one of these languages is available for literary expression to nearly every educated person whose mother-tongue lies outside of these two groups.

Perhaps this may be the appropriate place to call attention to the actual meaning of Article 36. The discussions at Vienna made it perfectly clear that when this article said "Latin diagnosis" it meant "diagnosis," not description. The supporters of this article emphasized the fact that it was expected that each author would write his *description* in the language of his choice, but must accompany this with a *diagnosis* in Latin, preferably in as few words as consistent with clarity, noting the important peculiarities of the novelty. This distinction between diagnosis and description has been almost universally ignored by those who have attempted to conform to the Rules—naturally so, as this article was printed with no explanatory annotation.

BIBLIOGRAPHIC NOTES

Saccardo, Sylloge fungorum **6**: 812

Hormomyces, Bon. Handbk. Hypsilophora Berk. & Cke. Grev. IX, p. 17.

The article in Grevillea in which *Hypsilophora* is referred to is Kalchbrenner and Cooke's South African fungi. *Hysilophora* does not appear on p. 17; but on p. 18 occurs *H. callorioides*. Under this species is the note "with the habit of *Dacrymyces,* but separated from that genus by Berkeley."

Berkeley published the genus *Hypsilophora* in a brief article in Gard. Chron. n. s., v. 11, p. 299, Mr. 8, 1879, entitled "*Hypsilophora destructor.*" He says it was published in Grevillea as a species of "*Dacrymyces,*" but does not agree with that genus, and goes on to propose the "name of *Hypsolophora*" with the species

Hypsilophora destructor and *H. syringicola.* From the above, as well as from Berkeley's own derivation for the generic name, it is evident that "*Hypsolophora*" is a typographical error. This spelling, however, appears in the index to the Natürlichen pflanzenfamilien, teil I, although in the text *Hypsilophora* is used.

Dacrymyces destructor and *D. syringicola* were originally described in *Berkeley's Notices of North American Fungi.* Grevillea **2**: 20. July, 1873.

Ceracea, Cragin, Saccardo, Sylloge fungorum **6**: 80.

This genus was described by Cragin in the *Bulletin of the Washburn Laboratory of Natural History,* v. 1, p. 82, Jan., 1885. It was noticed in the literature lists of the *Journ. Mycol.,* v. 1, p. 58, Ap., 1885.

Saccardo gives the title of Cragin's article and the page reference, but not the title of the publication in which it appeared; he also gives the *Journal of Mycology* reference, which has been taken by some writers as the original place of publication.

Just's Botanischer Jahresbericht. 1881

In trying to discover whether Patouillard published the genus *Sphaerula* previous to his Tabulae analyticae, 1883, I ran across *Sphaerula* in the index to Just's Bot. Jahresb. for 1881. The page reference was to the list of new species of fungi and here appeared *Sphaerula sagedioides* Winter on *Daucus carota.* This in turn referred to the referat in vol. 1 of 1881, p. 238 (I have not traced all the steps, as at this time the method used in Just was extremely complicated). The referat consisted merely of the title: Kunze, J. Fungi helvetici exsiccati, Cent. III–VI, and referred to a review in Oesterr. Bot. Zeitschr. 1880, p. 67. In the latter the species listed is *Sphaerella sagedioides* Winter and there is no *Sphaerula,* so that the reference in the index of Just and in the list of new species is a typographical error.

Lindau & Sydow, Thesaurus litteraturae mycologicae

On v. 1, p. 341, is listed: Dalman, Olaus. De fungis suecicis (Act. Holm. 1811, p. 157) "Act. Holm" is the abbreviation generally used for the series of the "Svenska vetenskaps-akademien

handlingar, and page 157 of 1811 is in Swartz's "Svamparter saknade i Flora Suec.," where reference is made to J. W. Dalman. This Dalman was an entomologist, and though evidently interested in fungi, I have not been able as yet to locate anything that he wrote on the subject. As to Olaus Dalman, I have not discovered that any such person existed. If any of the readers of *Mycologia* know to what this entry in Lindau & Sydow refers, I should be very grateful for the information.

ALICE C. ATWOOD

PORIA COCOS (SCHW.) F. A. WOLF

On June 14, 1915, I received from Mr. Edgar Nelson, who was then at Lebring, Florida, a large fresh specimen of tuckahoe encircling the root of a Eucalyptus tree which had recently died. On June 29 I wrote to Mr. Nelson as follows:

"I have your letter of June 23 regarding the habitat of the specimens recently sent me. I do not think the fungus caused the death of the Eucalyptus trees. It is found occurring on dead or decaying roots. Mr. M. E. Brown nearly twenty years ago found a number of these same sclerotia at Winter Park, Fla., and they were always attached to roots. What I should like to have you do would be to find some of the sporophores arising from the mycelial masses. If you could collect a number of them and plant them where they could be observed, I think you would have no difficulty in finally securing the desired results. This was done in Canada some years ago and a specimen of polypore (*Scutiger*) was obtained. If any of the fruit bodies are found, do not attempt to send them to me in the fresh state, but dry them first, taking careful notes on color.

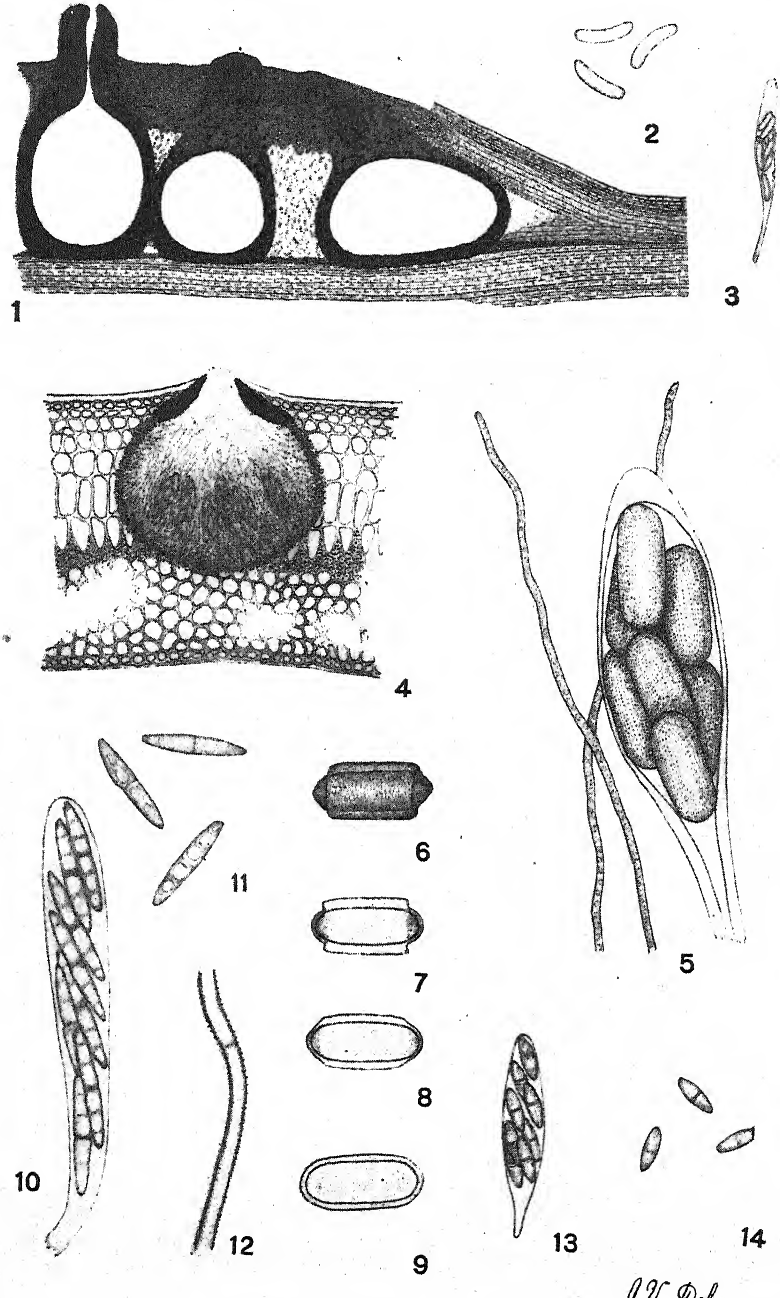
"The largest specimen you sent developed a *Poria*. This may have arisen from the dead wood as a separate thing, but it is well to look out for another yellowish *Poria* found associated with the sclerotia. Since Florida is said to be full of these interesting bodies, I am sure you ought to have considerable success, especially if you will give the subject some newspaper prominence and solicit coöperation."

Mr. C. E. Pleas, of Chipley, Florida, who claimed to have examined hundreds of specimens, said that they always occurred on dead roots, and that they were found mature at all seasons of the year. He mentions hickory as the host. R. J. Mendenhall states that there used to be many of them in North Carolina before the stumps disappeared. I tried to secure more specimens through Mr. Nelson, but failed; about that time the whole world became upset.

A paper by F. A. Wolf in the September number of the *Journal of the Elisha Mitchell Scientific Society* is of peculiar interest to me because he has carried out the study which I had in mind; although a good deal remains to be done by observations over a wide field before our knowledge of the southern tuckahoe is complete. Mr. Wolf's figures show exactly the same *Poria* that appeared on the specimen received from Mr. Nelson; so we may at once extend the range of hosts beyond "pine only."

Mr. Wolf's excellent paper includes an account of the history, structure, and origin of the southern tuckahoe; with the development and morphology of the fruiting stage, as observed after 175 years, upon sclerotia apparently parasitic on the roots of pine. Mature sporophores of the *Poria* type were secured by him on the surface of six different tuckahoes, and were also developed in cultures from tissue taken from central portions of large sclerotia.

W. A. MURRILL



Pyrenomycetes of Bermuda

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SOME PYRENOMYCETES OF BERMUDA[1]

José Vizioli

(With Plates 10 and 11)

The pyrenomycetes of Bermuda have been but little studied. Berkeley (1), accompanying the Challenger Expedition, collected only four species, while Seaver reports only thirty-three (24). Other small collections were made by Farlow, Dodge, and perhaps other mycologists, but no published records of these have been found. In all cases, however, the collectors having remained for only short periods, the forms found were few in number.

The most extensive collections were made by Whetzel in 1921–22. His presence in the island for a whole year enabled him to secure a large number of species. The variety of forms with notes regarding their host range and frequence in different seasons is sufficient to give a very nearly true conception of the fungous flora of Bermuda.

The unidentified pyrenomycetes in the collection have served as the basis for the present paper. Three new species are here described. One, *Endothia Coccolobii,* which occurs rather extensively along the seashore, may have been collected before, but not described by the previous collectors, probably on account of their failure to detect its perfect stage, which is much more limited in its occurrence than the pycnidial stage. The second species described is *Anthostomella Rhizophorae,* a very peculiar form on account of the unusual shape of its ascospores. The last is *Euty-*

[1] Also presented to the Faculty of the Graduate School of Cornell University as a major thesis in partial fulfillment of the requirements for the degree of Master of Science.

[Mycologia for March (15: 45–106) was issued March 30, 1923.]

pella linearis, which resembles *E. Bambusina* in habit and with which it can easily be mistaken.

In Bermuda some of the common North American species of *Hypoxylon* are represented, but are less common, while some of the rare North American Nectriaceae are found in abundance. Among these, *Ophionectria cylindrotheca* Seaver is perhaps the most common form.

The system of classification used in the present paper is that of Seaver (24) for the Hypocreales and that of Lindau (20) for the Sphaeriales. Britton's Flora of Bermuda was used as a guide for the names of the hosts, and Ridgway's Color Standards and Nomenclature for names of colors.

The writer wishes to express his thanks to Professor H. H. Whetzel, of the Department of Plant Pathology, Cornell University, for the courtesy of placing at his disposal a portion of his collections and field notebook; to Professor H. M. Fitzpatrick for supervising the work, for valuable suggestions, and for the revision and correction of the manuscript; and finally to Mr. W. R. Fisher for the care taken in making the photographs which illustrate this paper.

HYPOCREALES

NECTRIACEAE

NECTRIA Fries

NECTRIA PEZIZA (Tode) Fries, Summa Veg. Scand. 388. 1849.

MATERIAL EXAMINED: On fallen petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 8, 1922, H. H. Whetzel, Bermuda Fungi *74*.

Compared with: Rav. Fungi Am. *647* (Cornell Univ. Pl. Path. Herb. *10903*).

CALONECTRIA de Not.

CALONECTRIA ERUBESCENS (Roberge) Sacc. Syll. Fung. **2**: 545. 1883.

Perithecia, when young, clothed with tortuous, cream-buff, distantly septate, minutely verrucose mycelial threads 2.5–3 μ thick, which are more or less evanescent in age.

In a recent discussion of the genus *Calonectria,* Weese (33) states that the form described by Seaver (22) as *Calonectria erubescens* (Roberge) Sacc. is not that species, but probably *C. tubaroensis* Rehm, which is identical with *C. gurapiensis* Speg. and *C. leucophaes* Rehm. According to Weese, Seaver's material is identical with a specimen identified by Ellis, Plants of Florida *1955,* and differs from *C. erubescens,* which does not occur on remains of *Meliola* and possesses characters quite distinct from the American form. It is singular that Ellis made this misdetermination, for in the description of *C. erubescens* in N. Am. Pyren., Ellis and Everhart call attention to the fact that *C. leucorrhodina* (Mont.) Speg. "scarcely differs from this (*C. erubescens*) except in its epiphyllous growth." Since this character has no significance inasmuch as both forms are saprophytic, Ellis and Everhart's conception of the species was exactly the same as that of Weese, who states that no difference between the two can be found.

MATERIAL EXAMINED: On rotten petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 29, 1922, H. H. Whetzel, Bermuda Fungi *73;* on inflorescence of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 8, 1922, Cornell Univ. Pl. Path. Herb. *11911.*

OPHIONECTRIA Sacc.

OPHIONECTRIA CYLINDROTHECA Seaver, Mycologia 1: 70. 1909.

"This is the most abundant nectria found. The perithecia are white, barrel-shaped, and very minute; they never occur in clusters, but are gregarious, covering large areas on the underside of rotten petioles of *Sabal Blackburnianum* Glaz. in very moist places in Paget Swamp" (from Professor H. H. Whetzel's field notes).

MATERIAL EXAMINED: On rotten petioles and leaves of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 16, 1922, Cornell Univ. Pl. Path. Herb. *11912.*

CREONECTRIA Seaver

CREONECTRIA OCHROLEUCA Seaver, Mycologia 1: 190. 1909.

Seaver states that the perithecia are 200–300 μ in diam., but we have found in both of the specimens examined that they measure 160–240 μ in diam.

MATERIAL EXAMINED: On rotten petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 29, 1922, Cornell Univ. Pl. Path. Herb. *11913*.

Compared with: H. M. Fitzpatrick's Herb. *1751* (also Cornell Univ. Pl. Path. Herb. *4046*).

SPHAERIALES

CHAETOMIACEAE

CHAETOMIUM Kunze

CHAETOMIUM GLOBOSUM Kunze, Myc. Hefte 1: 15, 16. *fig. 9 a–d.* 1817.

Spores elliptic, 12–17 x 7.5–9 μ, with ends acute to slightly apiculate.

Except for the spore measurements, the material examined resembles closely *Chaetomium Fieberi* Corda (as pictured in Icones Fung. 1: 24, *pl. 7, fig. 293C*), which Chivers (5) considers the same as *Chaetomium globosum* Kunze, because of their great similarity and on the ground that Corda was probably dealing with different stages of the same plant when he described several species of *Chaetomium* as distinct from *C. globosum* Kunze.

MATERIAL EXAMINED: On fallen leaves of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 8, 1922, Cornell Univ. Pl. Path. Herb. *11895*.

Compared with: Cornell Univ. Pl. Path. Herb. *12089* (determined by A. H. Chivers).

SORDARIACEAE

PLEURAGE Griff.

PLEURAGE FIMISEDA (Ces. & de Not.) D. Griff. Mem. Torrey Club 11: 69–70, *pl. 8, fig. 1–5.* 1901.

MATERIAL EXAMINED: On cow dung, Paget Marsh, Jan. 1922, Cornell Univ. Pl. Path. Herb. *11909*.

SPHAERIACEAE

ROSELLINIA Ces. & de Not.

ROSELLINIA BREENSIS Starbäck Ark. Bot. 5^7: 17. 1905.

MATERIAL EXAMINED: On rotten sticks, Knutsford Paget, Feb. 20, 1922, H. H. Whetzel, Bermuda Fungi *75*.

Compared with: *type,* Exp. suec. in reg. Chaco-Andinis Fungi *165*.

ROSELLINIA DIDERMA (Schw.) E. & E. N. Am. Pyren. 175. 1892.

MATERIAL EXAMINED: On fallen petioles of palm, Fruitland, Aug. 1, 1921, Cornell Univ. Pl. Path. Herb. *11922*.

ROSELLINIA COCOES P. Henn. Hedwigia 47: 256. 1908.

Although the pruinose character of the perithecia is somewhat lacking, there seems to be no doubt that the material examined is the above species. We have also examined Sydow's Fungi Exot. *183* and have found that our material answers the description much more closely.

MATERIAL EXAMINED: On fallen petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Aug. 18, 1921, H. H. Whetzel, Bermuda Fungi *110*.

Compared with: Sydow, Fungi Exot. *183* (Cornell Univ. Pl. Path. Herb.).

AMPHISPHAERIACEAE

MELOMASTIA Nitschke

MELOMASTIA MASTOIDEA (Fries) Schroet.; Lindau, in E. & P. Nat. Pfl. 1: 414. 1897.

Melomastia Friesii Nitschke, in Fuckel, Symb. Myc. I Nachtrag 18 (306). 1871.

MATERIAL EXAMINED: On decorticated branches of *Lantana involucrata* L. ?, Paget, Dec. 8, 1921, H. H. Whetzel, Bermuda Fungi *145*.

CLYPEOSPHAERIACEAE

ANTHOSTOMELLA Sacc.

Anthostomella Rhizophorae sp. nov.

Perithecia epiphyllous, occurring in groups of 4–15 on circular spots 5–10 mm. in diam., globose, 0.5 mm. in diam., fleshy-membranous, soft, light-brown, papillate, with a circular ostiolum, clypeate; clypeus black, small, surrounding only the mouth of the perithecium; asci clavate, pedicellate, 135–192 x 40–60 μ, occasionally narrower, 8-spored; apex subacute; ascus wall disappearing before the spores are fully matured; paraphyses hyaline, simple, flexuous, nonseptate; spores subbiseriate to inordinate, when young, oblong, hyaline, at maturity, nonseptate, cylindric, 36–46 x 17–22 μ, brownish-olive to dark-grayish-olive; ends hemispheric, darker colored, nonapiculate to slightly so, contracted, the outer wall drawing away from the inner at the sides but not at the ends, partially collapsing with age, becoming wrinkled, but not falling away.

In all of the material examined only a single cluster of three pycnidia was observed associated with the perithecia. Whether this is the imperfect stage of the above species we are unable to state. Pycnidia sunken in the host tissue, small, erect-ellipsoid; pycnidial wall similar to that of the perithecium; pycnospores hyaline, nonseptate, ellipsoid, 4–4.5 x 2 μ, borne singly at the apices of simple, hyaline sterigmata.

The species is characterized by the very peculiar shape of the ascospore. As the spore matures, the inner wall thickens, and becomes darker colored at the ends. Later the whole spore gradually darkens, but because of changes which are probably chemical in nature the ends always remain darker than the rest of the spore and contract. As the spore undergoes these changes, the outer wall draws away from the inner, making it appear as if it were composed of an ellipsoid enclosed in a hollow cylinder with its ends projecting.

This species is closely related to *Anthostomella Rhizomorphae* (Kunze) Berl. & Vogl., from which, according to Berlese and Voglino's description (21; 11: 282), it differs chiefly in being epiphyllous, in the shape and size of the spores, and in not having a "rather hard perithecial wall."

Stevens determined as *A. Rhizomorphae* a fungus collected in

Porto Rico on *Rhizophora Mangle* L. We have examined his material (Cornell Univ. Pl. Path. Herb. *1276*) and have found that in certain points his description (30) does not agree with our observations. We have found the perithecia to average 540 μ in diam., but none of them reaches 600 μ, while Stevens gives the diameter as 700 μ; the spores are 34–43 x 17–22 μ instead of 24–40 x 14–17 μ as given by him, while the paraphyses are branched instead of simple.

Making the above corrections in Stevens's description and comparing the species, the outstanding differences between them are as follows:

A. Rhizomorphae (Kunze) Berl. & Vogl. (determined by Stevens), perithecia hypophyllous, equally distant from the upper and lower epidermis; spores oblong-ellipsoid to ellipsoid, with subacute ends; paraphyses branched, septate.

A. Rhizophorae sp. nov., perithecia epiphyllous, occupying the upper two thirds of the thickness of the leaf; spores cylindric, with hemispheric ends; paraphyses simple, nonseptate.

MATERIAL EXAMINED: Parasitic on leaves of *Rhizophora Mangle* L., Walsingham, Feb. 2, 1922, H. H. Whetzel, Bermuda Fungi *78*.

ANTHOSTOMELLA MINOR E. & E. N. Am. Pyren. 419. 1892.

Spores 7.5–8.5 x 3.3–3.7 μ.

Except for the somewhat wider spores as compared with 7–8 x 2.5–3 μ, given by Ellis and Everhart, the material examined corresponds exactly to the original description. The crustlike formation of the surface of the host, the connection of which with the perithecia could not be definitely ascertained by the above authors, was also observed in the material we have examined.

MATERIAL EXAMINED: On fallen petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Bermuda, Jan. 8, 1922, H. H. Whetzell, Bermuda Fungi *79*.

Compared with: Cornell Univ. Pl. Path. Herb. *7017* (determined by Ellis).

ANTHOSTOMELLA PALMICOLA (Auersw.) Rab.; Barbey Fl. Sard. Comp. 205 (revised by Franz v. Höhnel, Ann. Myc. **16**: 70–71. 1918).

The ostiolum surrounded by a sporodochium-like outgrowth of mycelial threads 2–3 μ thick, flexuous, branched, faintly septate, salmon-orange (brownish-yellow under the microscope); otherwise as in von Höhnel's description (17). Although no conidia could be found either free or attached to the mycelial threads of the above structure, its connection with the perithecium itself is questionable without positive experiments. Nevertheless we are for the present inclined to think that it represents the imperfect stage of the species.

MATERIAL EXAMINED: On old petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 8, 1922, Cornell Univ. Pl. Path. Herb. *11897*.

VALSACEAE

EUTYPELLA Nitschke

Eutypella linearis sp. nov.

Stromata subgregarious, occasionally fusing, oblong to linear, 1–2.5 mm. long, 0.3–0.5 mm. wide, formed by the blackened epidermis above, light-brown within, with a straight dark line which is sometimes lacking, continuous with the flat bases of the perithecia; perithecia monostichous, in a single longitudinal row, black, carbonous, flask-shaped, 250–380 μ in diam., sometimes narrower by mutual compression, about 580 μ high, with a neck 200–250 μ long, cylindric to slightly conoid, deeply quadrisulcate, non- to half-exserted; asci clavate, 18–30 x 4.5–5.5 μ (p. sp.), long-pedicellate, 8-spored, with a tip 7–15 μ long, tapering upward, terminating in an obtuse to almost blunt apex; paraphysate; spores hyaline-lutescent, allantoid, 8–10 x 1.6–2.3 μ, 2-guttulate, inordinate.

The species is closely related to *E. Bambusina* Penz. & Sacc., which differs chiefly in having short nonsulcate necks.

MATERIAL EXAMINED: On fallen bamboos, Agr. Exp. Sta. Grounds, Nov. 1921, H. H. Whetzel, Bermuda Fungi *120*.

EUTYPELLA SABALINA (Cooke) E. & E. N. Am. Pyren. 497. 1892.

MATERIAL EXAMINED: On fallen petioles of *Sabal Blackburnianum* Glaz., Paget Marsh, Jan. 8, 1922, H. H. Whetzel, Bermuda

Fungi *76;* on fallen petioles of *Sabal Blackburnianum* Glaz., Oct. 30, 1921, H. H. Whetzel, Bermuda Fungi *116*.

DIATRYPACEAE

DIATRYPELLA Ces. & de Not.

DIATRYPELLA VERRUCIFORMIS SPEGAZZINIANA Sacc. Syll. Fung. 1: 201. 1882.

Spore and ascus measurements identical with the ones given by Berlese in Icones Fung. 3: 117. 1905.

From materials of four collections of the above species made by Professor H. H. Whetzel, in Bermuda, three different types of stroma distribution were observed: *178*, scattered to subgregarious; *80* and *81*, gregarious; *77*, densely gregarious. This diversity of habit is noteworthy in regard to the extent of variations of specific characters. We have examined these three forms carefully and have concluded that a single species is concerned.

MATERIAL EXAMINED: On inner surface of fallen pods of *Delonix regia* (Bojer) Raf., Pembroke Hall Paget, Mar. 1922, H. H. Whetzel, Bermuda Fungi *178;* on rotting decorticated wood of *Lagenaria Lagenaria* (L.) Cockerell, Tom More's Tree, Walsingham, Jan. 20, 1922, H. H. Whetzel, Bermuda Fungi *77;* on limbs of unknown plant, probably *Morella cerifera* (L.) Small, Paget Marsh, Jan. 1922, H. H. Whetzel, Bermuda Fungi *80;* on limbs of unknown plant, probably *Morella cerifera* (L.) Small, Devonshire Swamp, Jan. 1, 1922, H. H. Whetzel, Bermuda Fungi *81*.

MELOGRAMMATACEAE

ENDOTHIA Fries

Endothia Coccolobii sp. nov.

Stroma cortical, gregarious, circinate, hemispheric to conoid, erumpent, orange-rufous above, lighter colored within, 0.5–1 mm. in diam., partially covered by the epidermis; perithecia 2–5 in a stroma, deeply sunk, leathery-membranous, coffee-black,[2] globose to subglobose, 290–420 μ in diam., provided with a long, slender, straight neck which projects 0.5–0.6 mm. above the surface of the stroma, externally of the same color and structure as the stroma

[2] Not in Ridgway's Color Standards and Nomenclature.

with an acute apex which terminates in a black circular ostiolum. Asci oblong to subclavate, thicker in the middle, 30–40 x 4–6 μ (p. sp. 22–30 μ long), 8-spored, short-pedicellate, pedicel not over 8 μ long, with subacute apex, aparaphysate; spores hyaline, 1-septate, nonconstricted at septum, ovoid to fusoid, 5.5–8 x 1.8–2.7 μ, one or both ends acute, irregularly biseriate to obliquely uniseriate in the ascus with the ends strongly overlapping. Conidial stage belonging to the form genus *Endothiella* Sacc.; stroma producing pycnidia the same or similar to those producing perithecia, becoming black; pycnidia coffee-colored, formed by irregular cavities opening into a single black (externally and internally) conoid papilla which terminates in a circular ostiolum; sporophores slightly flexuous, hyaline, simple or only rarely branched at base, 12–20 μ long, occasionally much longer (up to 45 μ); pycnospores hyaline, bacilliform, 2–3 x 0.8–1 μ.

The above species differs from *E. longirostris* Earle, which is closely related, in the smaller size of the projecting beak of its perithecium, and from the other species of the genus in the smaller number of perithecia in a stroma and in lacking the gelatinous envelope of the spores.

MATERIAL EXAMINED: On fallen green fruits of *Coccolobis uvifera* (L.) Jacq., Grape Bay, Dec. 11, 1921, H. H. Whetzel, Bermuda Fungi *147*.

XYLARIACEAE

HYPOXYLON Bull.

HYPOXYLON COCCINEUM Bull.; E. & E. N. Am. Pyren. 629. 1892.

MATERIAL EXAMINED: On fallen limbs of *Amygdalus persica* L., Knutsford Paget, Nov. 1921, H. H. Whetzel, Bermuda Fungi *121*.

Compared with: E. & E. Fungi Columb. *733* (Cornell Univ. Pl. Path. Herb.); Cornell Univ. Pl. Path. Herb. *1326*.

HYPOXYLON RUBIGINOSUM (Pers.) Fries; E. & E. N. Am. Pyren. 645. 1892.

MATERIAL EXAMINED: On dead sticks and twigs, Knutsford Paget, Feb. 20, 1922, H. H. Whetzel, Bermuda Fungi *82*.

Compared with: E. & E. Fungi Columb. *838* and *1324* (Cornell Univ. Pl. Path. Herb.); Rav. Fungi Am. *654* and *741* (Cornell Univ. Pl. Path. Herb.).

HYPOXYLON MINUTUM Nitschke, Pyren. Germ. 54. 1867.

Sphaeria confluens Fries, Syst. Myc. 2: 342. 1823. Not *S. confluens* Willd. 1787.

MATERIAL EXAMINED: On rotten sticks, Paynters Vale, Apr. 23, 1922, H. H. Whetzel, Bermuda Fungi *179*.

HYPOXYLON EFFUSUM Nitschke, Pyren. Germ. 48. 1867.

Perithecium 0.4 mm. in diam. and spores 6–7 x 2.5–3 μ.

MATERIAL EXAMINED: On log of *Persea Persea* (L.) Cockerell, Devonshire, Mar. 7, 1922, Cornell Univ. Pl. Path. Herb. *11900;* on old decorticated wood of *Melia Azedarach* L., Paget East, Oct. 1921, Cornell Univ. Pl. Path. Herb. *11901;* on fallen limbs of *Amygdalus persica* L., Whetzel's Garden, Paget, Nov. 1921, H. H. Whetzel, Bermuda Fungi *122*.

Compared with: E. & E. N. Am. Fungi *2114* (Cornell Univ. Pl. Path. Herb.).

XYLARIA Hill

XYLARIA ARISTATA Mont. Syll. Crypt. 205. 1856.

The species *Xylaria marasmoides* Berk. and *X. axifera* Mont. have been referred to by Theissen as synonymous to *X. aristata.* This is an error according to Lloyd (19), for these three forms, though related, are specifically distinct from each other. While *X. marasmoides* is evidently distinct from *X. axifera, X. aristata* can be readily distinguished from these two by the tubercular character of its fertile head.

MATERIAL EXAMINED: On fallen leaves of *Jasminum simplicifolium* Forst, Walsingham, Jan. 12, 1922, H. H. Whetzel, Bermuda Fungi *165*.

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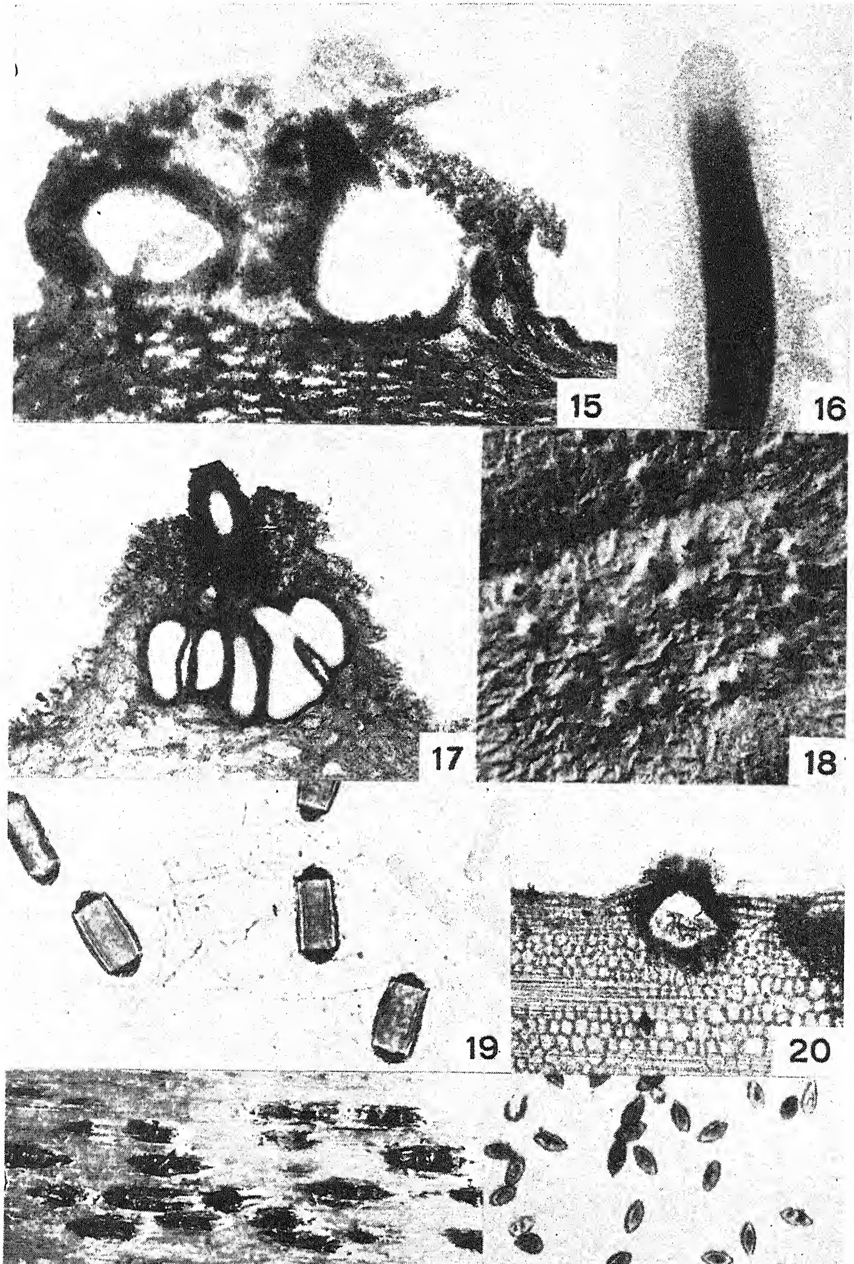

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EXPLANATION OF PLATES

PLATE 10

Fig. 1. *Eutypella linearis.* A section of the stalk of bamboo showing the stroma with three perithecia. × 60.

Fig. 2. *E. linearis.* Three mature spores. × 910.

Fig. 3. *E. linearis.* An ascus. × 400.

Fig. 4. *Anthostomella Rhizophorae.* A section of a leaf showing the perithecium. × 60.

Fig. 5. *A. Rhizophorae.* An ascus with immature spores and paraphyses. × 400.

Fig. 6. *A. Rhizophorae.* A fully mature spore. × 400.

Fig. 7, 8, 9. *A. Rhizophorae.* Three spores at different stages of maturity, as seen in longitudinal sections. × 400.

Fig. 10. *Calonectria erubescens.* A mature ascus. × 910.

Fig. 11. *C. erubescens.* Three spores at different stages of maturity. × 910.

Fig. 12. *C. erubescens.* A portion of the mycelial threads which radiate from the perithecium showing the verrucose character. × 910.

Fig. 13. *Endothia Coccolobii.* An ascus. × 910.

Fig. 14. *E. Coccolobii.* Three mature spores. × 910.

PLATE 11

Fig. 15. *E. Coccolobii.* A section of the cortex of a fruit showing the stroma with two perithecia. × 65. The long beaks of the perithecia are not shown here.

Fig. 16. *E. Coccolobii.* Free portion of the beak of a perithecium showing the stromatic structure of the outer layer. × 90.

Fig. 17. *E. Coccolobii.* A section of the cortex of a fruit showing a stroma with the pycnidial cavities opening into a single, black, homogeneous, short beak. × 65.

Fig. 18. *Anthostomella Rhizophorae.* Portion of the upper surface of a leaf showing the clypei of the perithecia. × 8.

Fig. 19. *A. Rhizophorae.* A group of spores at different stages of maturity. × 330.

Fig. 20. *A. palmicola.* Section of a petiole showing a perithecium with the sporodochiumlike structure at the apex. × 65.

Fig. 21. *Eutypella linearis.* Surface of the stalk of bamboo showing the stromata. × 8. The photograph taken near the node: the stromata are not typically elongate to linear here.

Fig. 22. *Chaetomium globosum.* A group of spores. × 330.

LIFE HISTORIES AND UNDESCRIBED GENERA AND SPECIES OF FUNGI

C. L. Shear

(With Plates 12 and 13)

It may not be wholly inappropriate to preface this article with something of an apology for perpetrating more names and descriptions of fungi on a long suffering mycological and pathological public. To paraphrase the oft-quoted saying about books: Of the *naming of species* there is no end!

The chief extenuating circumstance I can offer in this case is that after much search of herbaria and literature, no descriptions have been found which seem to apply to the fungi considered here, and since some of these organisms have forced themselves upon us by causing disease or decay in some of the plant products which we are supposed to help guard and protect, and as we are called upon to discuss them in their pathological and morphological or other aspects, it seems necessary to have names to apply to them. Someone may tomorrow find that one or more of these so-called "new species" has already been described. If so, we repeat our apologies, and gladly accept the previous name. The essential thing is that the organisms be represented in herbaria by good specimens and be so described or illustrated that they can in the future be identified with a reasonable degree of certainty. Our successors with their advanced knowledge may find, however, that we have accomplished our aim in this respect, but little, if any, better than our predecessors, most of whom presumably utilized the knowledge and facilities available to them without meeting present-day requirements.

Schizoparme[1] gen. nov.

I. *Perithecia* separate, embedded, submembranous to membranous, bearing about the ostiole and upper half a pseudoparenchymatous epistroma which ruptures the surface of the host

[1] From Greek *schizo*, to divide or split, and *parme*, a small shield.

and splits radially, exposing the ostiole; paraphyses none; ascospores hyaline or yellowish, nonseptate.

II. *Pycnia* very similar in character and appearance to the perithecia, having the same form of epistroma which ruptures in the same manner; spores hyaline, or pale-yellowish in mass, nonseptate, borne on a pulvinus at the base of the pycnium.

III. *Conidia* unknown or wanting.

Type: S. straminea.

Schizoparme straminea sp. nov.

I. *Perithecia* scattered or gregarious, embedded or erumpent, frequently associated with the pycnia, submembranous to membranous, 100–500 μ in diameter, surmounted by a circumostiolar

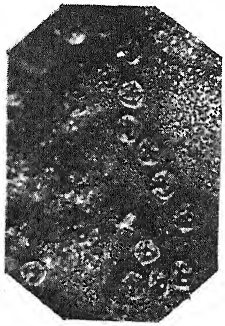


FIG. 1. *Schizoparme straminea.* Vertical view of a perithecium, showing the quadrifid, discoid epistroma on an old rose leaf.

epistroma same as in the pycnia, usually collapsing when dry and the epistroma splitting radially, thus exposing the papillate ostiole; asci cylindric or elongate-elliptic, sessile or very short-stipitate, 40–50 x 8–10 μ, with an apparent thickening at the apex and a slight protuberance projecting downward; paraphyses wanting; ascospores hyaline or pale-yellowish when old, nonseptate, elliptic, fre-

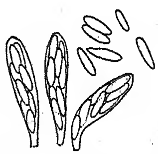


FIG. 2. *Schizoparme straminea.* Asci and ascospores. × 420.

quently slightly inequilateral or curved, 11–13 x 3–4 μ; apparently surrounded by a thin mucilaginous envelope which sometimes causes the appearance of a slight appendage at the end of the spore.

II. *Pycnia* scattered or gregarious, embedded or erumpent, submembranous to membranous, collapsing when mature and dry, pro-

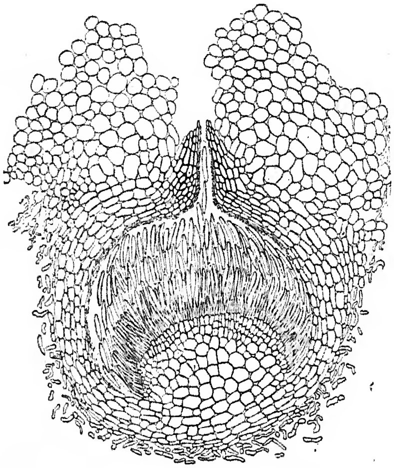


FIG. 3. *Schizoparme straminea.* Median vertical section of a pycnium from strawberry fruit, showing the loose tissue of the epistroma about the upper portion of the pycnium.

vided above with a straw-colored epistroma about the apex which ruptures radially, exposing the papilliform ostiole; globose or subglobose, 100–350 μ in diameter; sporophores simple, tapering, 10–15 μ long, borne on a pulvinus at the base; pycnospores, elongate-elliptic, straight or slightly irregular and inequilateral, hyaline, becoming pale-greenish-yellow in mass, nonseptate, 15–20 x 3–4 μ.

Type: C. L. Shear 3568, on old fallen leaves of *Rosa rugosa prostrata,* rose garden, Arlington Farm, Va., September 6, 1920; also slide of same number from the same specimen.

First found in its pycnial form by Dr. B. O. Dodge on strawberries from Norfolk, Va.; also one or both stages on dead leaves of strawberry, *Castanea, Prunus, Quercus, Rhus, Rubus, Salix,* and *Vitis* in Maryland and Virginia in the vicinity of Washington, and on *Eucalyptus,* Miami, Florida, from June to October, and on *Quercus* in Italy associated with *Sporonema quercicolum* C. Massalongo (*Sclerotiopsis concava* (Desm.) Shear & Dodge) on a part of the type specimen of that species kindly contributed by its author.

RELATIONSHIP

The pycnia resemble *Coniothyrium diplodiella* (Speg.) Sacc., so well described and illustrated by Istvanffi in his monograph, "Sur le rot livide." That has a similar development of fungous tissue about the ostiole and a pulvinus in the bottom of the pycnium. The perithecial form, said by Viala and Ravaz to belong to this *Coniothyrium,* was described by them as a new genus, *Charrinia.*

According to their description this differs from *Schizoparme* in having paraphyses and 1–3-septate ascospores and lacking the perithecial epistroma. In general character of the perithecia and spores, *Schizoparme* seems related to some of the species described under *Physalospora. Coniothyrium diplodiella* is not, however, a true *Coniothyrium,* and the pycnial form of *Schizoparme* can not properly be referred to that form-genus, the type of which, as pointed out by von Höhnel, is *Leptothyrium pini* (Corda) Sacc. Much more work is necessary before any satisfactory disposition can be made of the various pycnial forms of the Ascomycetes. We are unable at present to refer the pycnial form of *Schizoparme* to any particular form-genus and do not consider it desirable to add another generic name to the great superfluity already existing.

CULTURES

As the small hyaline ascospores are difficult to isolate, most of the ascospore cultures were made from single asci which could be readily separated and isolated in poured plates. Over one hundred such single ascus cultures have been made. In all cases the characteristic pycnia were produced, but no perithecia were ever found, though cultures were kept on different media for a long time. The ascospores germinate in a few hours at ordinary room temperatures in summer. A thin, white, superficial, circular growth of hyphae is produced in a few days. This growth has a more or less lobed or broadly crenate margin. Pycnia are formed in concentric circles and begin to mature in five or six days. Cultures from pycnospores develop in the same manner, and produce the same characteristic pycnia. The pycnia in culture frequently become aggregated and more or less united in small groups. A detailed description and discussion of the development of the pycnia

has just been published by Dr. B. O. Dodge, Jour. Agr. Res. **23**: 743. Apr. 25, 1923, to whom we wish to acknowledge our great indebtedness for assistance, especially in connection with the illustrations.

Fragosphaeria gen. nov.[2]

I. *Perithecia* colored, carbonaceous, brittle, astomous, sutured, dehiscing into numerous, more or less regular, polygonal segments at maturity.

III. *Conidial* form consisting of a thin, white, effuse growth of hyphae; fertile portions alternately branched, bearing hyaline nonseptate spores on the more or less enlarged ends of the branches.

Fragosphaeria purpurea sp. nov.

I. *Perithecia* deep dark-purple, opaque, globose, carboneous, brittle, astomous, breaking into numerous, mostly pentagonal segments when old or crushed; asci subglobose, 4–6 μ in diam., held together in irregular compact globose masses, see fig. 4, by branch-

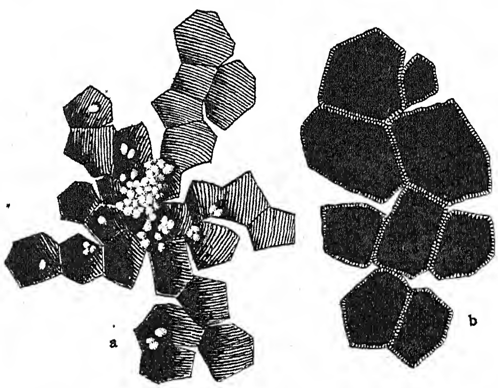


FIG. 4. *Fragosphaeria purpurea.* (a) Ruptured perithecium showing the segments into which the wall divides and the subglobose masses of ascospores. (b) Segments of a perithecial wall showing the sutures. Highly magnified.

ing stipes, soon becoming evanescent; paraphyses none; ascospores yellowish-brown in mass, flattened on one side or broadly bean-shaped, 2.25–2.75 x 1.5–2 μ. The ascospores tend to adhere in globose masses after the asci have disappeared.

II. *Pycnia* unknown.

III. *Conidial* form[3] thin, white, effuse, much branched; conidia

[2] From *fragor*, a breaking to pieces, and *sphaera*, a sphere.

[3] This seems referable to the genus *Rhinotrichum*.

formed on somewhat enlarged, elongated and roughened ends of the alternately branched fertile hyphae, oblong-elliptic, inequilateral or suballantoid, nonseptate, hyaline, 3–4 x 1–15 μ.

Type: Pure culture tube *4821* on corn meal agar. This fungus appeared in poured plates of *Pilacre petersii* gathered on a beech log near Chain Bridge, Va., September 19, 1920, and has since been kept in pure culture on different media.

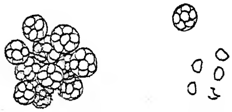


FIG. 5. *Fragosphaeria purpurea.* Asci and ascospores. × 800.

It seems to produce conidia and perithecia best on oatmeal paste to which 1 per cent glycerine has been added. It also fruits on corn meal agar with 1 per cent glycerine. It first forms a thin white growth of hyphae, which soon produces conidia, and the agar becomes dark-purple about the colony. In from ten days to two weeks the globose, dark-purple perithecia appear.

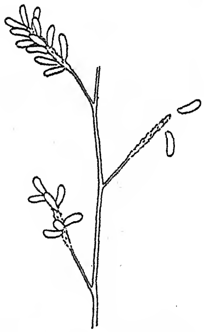


FIG. 6. *Fragosphaeria purpurea.* Conidiophores and conidia. × 800.

This genus is evidently closely related to such genera as *Pleuroascus, Magnusia,* and *Arachnomyces.* It differs, however, from these genera, as illustrated by Massee and Salmon in their paper on Coprophilous Fungi, Ann. Bot. **16**: 68–70, in being without appendages, or at least any of a definite character, and also in the mode of dehiscence of the perithecia. The spore characters are very similar, but the asci in those genera are not described as

occurring in masses united by branching stipes as is the case in *Fragosphaeria*.

Peridoxylon gen. nov.

Stroma fleshy to coriaceous; perithecia tough membranous, immersed in several series in the upper or distal portion of the stroma, the perithecial part of the stroma covered at first with a membranous or subcoriaceous peridium which ruptures irregularly breaking up into fragments and disappearing except for a border about the margin; asci 8-spored, spores dark-colored, nonseptate; paraphyses filiform, obscure.

Type: Hypoxylon petersii B. & C.

This species was first described by Berkeley and Curtis in 1869 as *Hypoxylon petersii,* from specimens collected by Judge Peters in Alabama. A fuller description was given by Ellis & Ev. Jour. Myc. 4: 39. 1888, from additional specimens collected by Morgan in Ohio and Kentucky. Their description agrees in all essential particulars with the specimens gathered by the writer on decaying oak branches in the woods at Arlington Cemetery, Virginia, August, 1922. Specimens have also been reported from Indiana. Aside from its dark-colored, nonseptate spores, this fungus bears little resemblance to *Hypoxylon,* and is evidently not congeneric with the other species of that genus. In character of stroma this genus is closely related to the Hypocreaceae, but there is no clear-cut line of demarcation between the Hypocreaceae and Xylariaceae. Entirely too much taxonomic significance has been given to the substance of the stroma in separating these two families. Why should the character of the tissue of the stroma be of any more taxonomic importance generally than is the character of the tissue in higher plants? As mycologists we are still apparently in many respects in what corresponds to the mediaeval stage in the development of our taxonomy.

The following genera of Pyrenomycetes having fleshy stromata and similar spores are more or less related to this genus.

Galziella. Berkeley described this in his paper on Fungi Brasiliensis, 1880 in the Proceedings of the Natural History Society of Copenhagen as having a subglobose, fleshy, bright-colored stroma and pale perithecia filled with gelatin. The single species, *G. vesiculosa,* was mentioned, but not described. Lloyd has attempted

to identify this, but we are inclined to agree with Moeller that the name should be discarded, as no ascomycete can be satisfactorily recognized without a description of the asci and ascospores. In any case there is no reason to suppose that our specimens belong here.

Sarcoxylon. Cooke, Grevillea **12**: 50. 1883, established this genus and described it as having a rather fleshy, pale or bright-colored, subglobose, pulvinate or depressed stroma; perithecia submembranous. No cuticle or peridium was mentioned. Two species, *S. compunctum* (Jungh.) and *S. lycogaloides* (B. & Br.), were referred to it. Neither species is described as having a peridium or perithecia in more than one series.

Penzigia. Saccardo, in Mycetes Malaccae 20. 1888, described this as having a subglobose, hemispheric, or pyriform stroma, radiate-fibrose within, black, crustaceous, smooth; perithecia covering the stroma, immersed. This is apparently related to *Daldinia,* but is said to differ in color and nonzonation of the stroma.

Thuemanella. Penz. & Sacc. Malpighia **11**: 518. 1897. The type of this genus is *T. javanica* Penz. & Sacc. It has a fleshy, subglobose, yellow stroma with perithecia embedded and scattered over the surface in an irregular single series. No peridium is mentioned and the illustration shows no suggestion of any. The author says this is related to *Sarcoxylon,* but the stroma is truly hypocreaceous and the texture not radiate.

Engleromyces. P. Henn. Engl. Jahrb. **28**: 327. 1900. This is described as having a globose, fleshy, soft, black stroma, nonzonate inside with perithecia pluro-stratose. The type is *E. Goetzii,* having a black rugulose-verrucose cortex, and soft-fleshy or cheesy inside. The stroma is at first covered with a superficial conidial layer. This differs from *Peridoxylon* in having the perithecia distributed over the whole stroma and lacking a peridium.

Entonaema and *Xylocrea.* Moell. Phyco. and Asco. Braz. 301–307. 1901. These are genera having fleshy stromata with perithecia in a single series and without a peridium.

It is clear from the descriptions and figures and from the specimens we have seen that *Engleromyces* is more nearly related to our fungus than any other genus we have found described. *Peri-*

doxylon differs, however, from that in having the perithecial layer restricted to the distal portion of the stroma and in being covered at first with a peridium. In fact, the presence of the peridial membrane is a most remarkable feature not found in any other known pyrenomycete, so far as we have been able to discover. The character and structure of the stroma is also very characteristic and different from most other Xylariaceae or Hypocreaceae. In its fresh condition the plant might at first glance be easily mistaken for the discomycete, *Sarcosoma rufa* (Schw.). The substance of the stroma, color, and general shape are very much the same. The first noticeable difference is the dark-colored surface of the perithecial layer, and upon closer examination, of course, the presence of the peridium forming the border about the margin after it has ruptured and the greater part disappeared.

The surface of the perithecial portion of the stroma when fresh looks as though covered with a thin film of India ink. This on microscopic examination proves to be a coating of the ascospores, which are expelled in large quantities and held together apparently by mucilaginous matter. This coating slowly dries, giving the surface a shining, deep smoky-black color. The stroma is fleshy-gelatinous when fresh, very elastic under pressure, shrinking much in drying and becoming at first coriaceous and finally quite hard. The inside of the stroma is chestnut-brown in section and somewhat lacunose, as shown in pl. 12, fig. 1; that is, there are various shaped, small cavities, some elongated and narrow. The peridium in our specimens had largely disappeared except for an irregular border; but from the large broken irregular fragments remaining attached near the margin of the stroma and on the ground it was very evident that it had at first entirely covered the perithecial portion. This peridium is 1–2 mm. thick and membranous or subcoriaceous. The stromata are mostly broadly conoid-truncate; outside rough from adhesion of the decaying wood of the substratum. The perithecia are very numerous, crowded and irregularly arranged in 5 or 6 series in the stroma, as shown in pl. 12, fig. 1. The perithecial walls are tough-membranous and slightly darker than the stromatic tissue. The spores are dark-blue-black in mass and concavo-convex or collapsed; as can readily be demon-

strated by rolling them over by pressure on the cover glass, ovoid to elliptic, 6–8 x 3.5–4 μ.

Among the usual Xylariaceae the only species which suggest a relation to this in stromatic character or arrangement of perithecia are *Nummularia lutea* A. & S., a European species which has the perithecia in several irregular series in a coriaceous yellow stroma, but without a peridium; and a species referred to *Hypoxylon* by Berkeley, *H. ovinum*, Grev. **11**: 129, 1883, which is described as hemispheric, dark-purple, hard, smooth, shining, dark within with perithecia black and stratose. This might belong to the same genus as *P. petersii* if it had a peridium, but none is mentioned, although even in dried specimens, if present, the remains should be evident about the margin of the distal portion.

Phyllostictina carpogena sp. nov.

Pycnia gregarious or somewhat scattered, erumpent, the upper half finally more or less exposed, globose, subglobose or pyriform, subcarboneous, black, usually with a papillate beak, ostiolate.

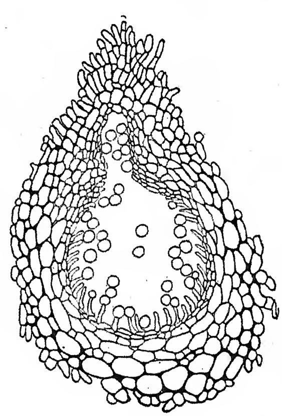


FIG. 7. *Phyllostictina carpogena.* Vertical section of a pycnium.

Spores globose or irregularly subglobose, continuous, hyaline or pale-yellowish in mass, smooth, 5–7.5 x 4.5–6 μ; sporophores pyriform or obclavate, 5–10 x 1.5–2.5 μ.

Type: B. O. Dodge 3701 on decaying Leucretia dewberry from Cameron, North Carolina, August 1919. Illustration, pl. 13, fig. 3, from section of the same, *3701.* Typical specimen also on dead

cane of the Leucretia dewberry, Jonesboro, North Carolina, April 1922, *B. O. Dodge 4030.*

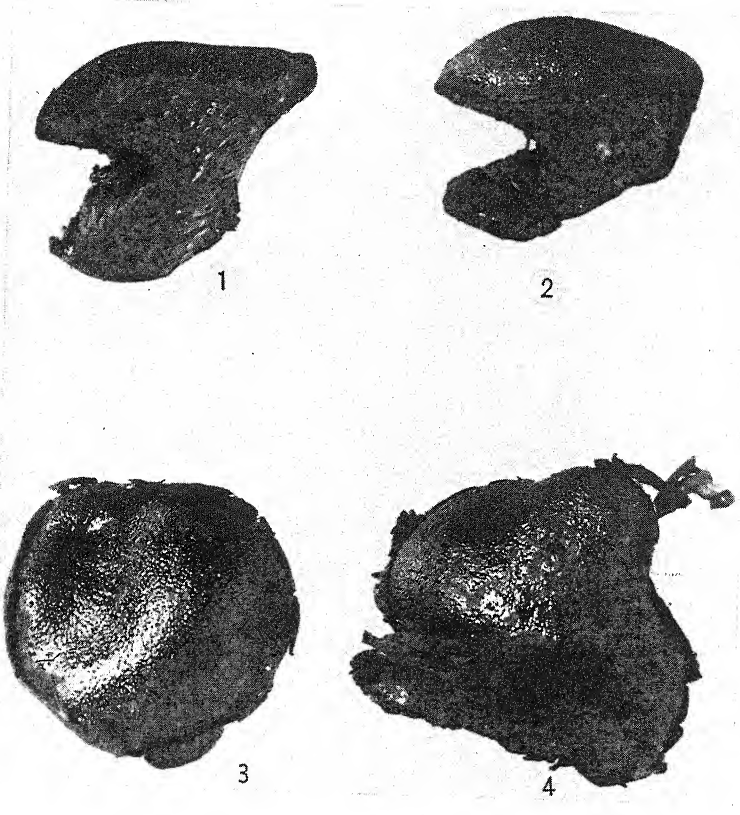
This fungus is not uncommon on old dead dewberry vines in North Carolina and also in the vicinity of Washington, D. C., and has frequently been found in the Washington and New York markets, causing rot of dewberries grown in North Carolina.

In mode of development and character of the pycnia and spores this form shows very close relationship to the pycnial stage of the black-rot fungus of the grape, *Guignardia bidwellii.* The distinctive features in the development of the pycnia have been studied by Dr. Dodge, who has just published a paper on the subject. There is little doubt in the mind of the writer that this is the pycnial stage in the life-history of a Guignardia. A perithecial form of the Guignardia type has been found on dead dewberry vines in the same locality, which agrees with the description of *Physalospora carpogena* Atk. Bull. Cornell Univ. 3: 8. 1897, found on old seeds of blackberries. We have not yet been able to get ascospore cultures of this, but hope to later.

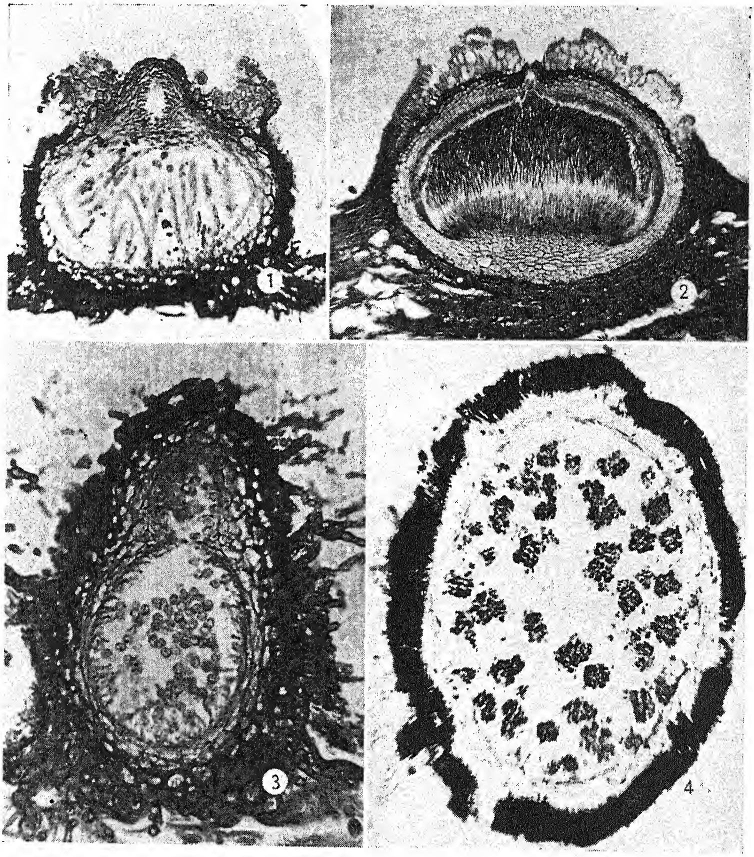
This pycnial form is referred to the form-genus *Phyllostictina* Syd., 1916, the monotype of which, *P. murrayae* Syd., is discussed by von Höhnel, 1920, who shows its close relationship to the pycnial form of the common black-rot fungus on grape, *Guignardia bidwellii.*

The names *Phoma* and *Phyllosticta* have been applied to such a large number of miscellaneous and heterogeneous pycnial forms that they have lost all definite taxonomic significance they may ever have had and should either be anchored to a particular type species and restricted to forms congeneric with it or discarded.[4] *Phyllostictina* in the sense in which it is here used should be restricted in its application to the pycnial forms of the genus *Guig-*

[4] Seaver, 1922, N. Am. Fl. 6: 3, indicated the type of *Phyllosticta, P. Convallariae* Pers., but included in the genus a large number of forms having very different characters and life histories from the type. V. Höhnel, 1918, Ann. Myc. 16: 98–101, discussing *Phoma* of Fries, 1819, refers to the original monotype, *Sphaeria pustula* = *Hypospila pustula* of recent authors; but decides that the type should be *P. saligna* taken from Fries' later work, Syst. Myc. 1823, where that species happens to be given first. Adopting either of these species as the type would place the genus in the Pyrenomycetes instead of the Imperfecti.



Peridoxylon petersii (Berk. & Curt.) Shear



Schizoparme straminea Shear

nardia, as applied to species congeneric with the common *G. bidwellii.* All the pycnia of this type so far investigated show histolysis of the pseudoparenchymatous tissue, which at first fills the pycnium, resulting in its containing at maturity much mucilaginous matter which envelops the spores and causes them to adhere in a more or less globose mass when they are expelled from the pycnium by crushing it. Of a similar character apparently is the granular appendage frequently found at the apex of the pycnospore. This is easily observed in **Phyllostictina vaccinii** comb. nov., the pycnial form of *Guignardia vaccinii* Shear.

Phyllosticta solitaria E. & E. is a good Phyllostictina, agreeing in every essential respect morphologically with *P. carpogena* and *P. bidwellii,* and probably has Guignardia as its ascogenous fructification. *P. congesta* Heald & Wolf also belongs here.

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EXPLANATION OF PLATES

PLATE 12

FIG. 1. *Peridoxylon petersii.* Median vertical section of a stroma showing the irregular series of perithecia and the lacunae in the stroma. Nat. size.

Fig. 2. *P. petersii.* Opposite view of same. Nat. size.

Fig. 3. *P. petersii.* Vertical view of a stroma showing the perithecial portion with the marginal remains of the peridium. Nat. size.

Fig. 4. *P. petersii.* Lateral view of compound stroma showing remains of the peridium. Nat. size.

PLATE 13

Fig. 1. *Schizoparme straminea.* Median vertical section of a perithecium from *Rhus copallina,* showing papilliform beak and remains of the epistroma. × 160.

Fig. 2. *S. straminea.* Median section of a pycnium from the same host, showing papilliform beak and remains of the epistroma. × 200.

Fig. 3. *Phyllostictina carpogena.* Section of a pycnium from fruit of dewberry. × 285.

Fig. 4. *Fragosphaeria purpurea.* Median section of a perithecium showing sutures in the perithecial wall and irregular masses of asci. × 100.

VARIETAL RESISTANCE AND SUSCEPTIBILITY OF SORGHUMS TO SPHACELOTHECA SORGHI (LINK) CLINTON AND SPHACELOTHECA CRUENTA (KÜHN) POTTER[1]

George M. Reed

(With Plates 14 and 15)

Very extensive investigations on the resistance and susceptibility of varieties of sorghum (*Holcus Sorghum* L.) to the covered kernel-smut (*Sphacelotheca Sorghi* (Link) Clinton) have been carried out.[2] Practically all of the varieties of sorghums, many of which were represented by a number of different strains obtained from various sources, were grown.

As a result of these investigations it was found that the strains and varieties of broom corn, kafir, shallu, and sorgo were quite susceptible to the covered kernel-smut, giving relatively high percentages of infection. Two varieties of durra, the common Brown and White durra, also proved highly susceptible. However, in recent years a number of introductions of White durra have been made and some of these have shown a high degree of resistance. The kaoliangs, as a group, were only moderately susceptible; a few varieties like Barchet, Blackhull, Manchu Brown, and Valley kaoliang gave relatively high percentages of infection; on the other hand, Dwarf Brown kaoliang has consistently proved to be resistant. All varieties and strains of milo and feterita have shown very marked freedom from infection. Several miscellaneous sorghums were also grown and some, for example, Schrock kafir and

[1] Brooklyn Botanic Garden Contributions No. 30.

[2] These results, which have been written up by the author in coöperation with Professor L. E. Melchers, are based upon experiments conducted at Columbia, Mo. (4 years); Manhattan, Kan. (6 years); Amarillo, Tex. (4 years); Arlington Experiment Farm, Va. (2 years); and Brooklyn, N. Y. (2 years). The manuscript has been submitted for publication as a Bulletin of the U. S. Dept. Agr.

Freed sorgo, were infected to a greater or less extent. Others, as Darso, Dwarf Hegari, Kafirita, and Sudan corn, gave negative results.

Observations on the head-smut (*Sorosporium Reilianum* (Kühn) McAlpine) of sorghum were also made at Amarillo, Texas, where soil infestation appears to be prevalent. No infections of broom corn, feterita, and milo were observed. A low percentage of infection occurred in several varieties of kafir and kaoliang, and somewhat higher percentages of infection in certain varieties of sorgo. However, only eight varieties of sorghum showed conspicuous susceptibility to the head-smut: Brown durra (*S. P. I. 17537*); White durra (*S. P. I. 17535*); Black Amber sorgo (*S. P. I. 32384*); Minnesoto Amber sorgo (*F. C. I. 01950*); Red Amber sorgo (*S. P. I. 1534* and *17548*); Coleman sorgo; Early Rose sorgo; and Schrock kafir.

Potter (27) and Kulkarni (20) have recorded some results with the loose kernel-smut (*Sphacelotheca cruenta* (Kühn) Potter). Potter reported that he was unable to infect milo with this smut, but with some other sorghums he obtained the following percentages of infection: Amber sorgo, 10.9 per cent; Freed sorgo, 5 per cent; broom corn, 6.9 per cent; kafir, 13.8 per cent; and kaoliang, 10.3 per cent.

Kulkarni (20) inoculated seed of Dwarf milo with the spores of both covered and loose smut and planted it at the Agricultural College Farm, Poona, India. Apparently the same lot of seed was inoculated with the spores of both smuts. He obtained a total of 645 heads, of which three were infected by *Sphacelotheca sorghi* (.47 per cent infection) and fifty by *S. cruenta* (7.8 per cent infection). The three plants infected by *S. Sorghi* may have been some other sorghum which was accidentally present in the plot. It is a question, however, whether the results with *S. cruenta* can be thus explained.

The writer has continued his investigations on the behavior of sorghum varieties to covered kernel-smut (*Sphacelotheca Sorghi* (Link) Clinton) and, in addition, has carried out a series of experiments with the loose kernel-smut (*S. cruenta* (Kühn) Potter).

Sphacelotheca Sorghi is a typical kernel-smut, the individual

ovaries of the flowers being involved and converted into false kernels, or smut balls. It is unquestionably the most widely distributed and destructive smut which attacks sorghums and is probably to be found wherever these plants are grown. It was first described, from a specimen collected in Egypt, by Link (23) in 1825. Since then it has been recorded by a large number of observers. Barber (2), Kulkarni (19), and Butler (10) note its prevalence in various parts of India, where it is a destructive disease of sorghums in the Madras Presidency, Bombay Presidency, the Central Provinces, and Burma. A large number of seed lots of Chinese kaoliangs have been imported into the United States and Ball (1) states that most of them were contaminated with the spores of this smut. This indicates its prevalence in those parts of China where kaoliangs are grown. Miura (25) mentions its occurrence in Manchuria; Bubák (6) and Thomas (31) in Mesopotamia; Busse (9) in Tanganyika Territory (formerly German East Africa); Snowden (30) in Uganda; Evans (13) in South Africa, especially on kafirs; McAlpine (24) in Australia; Hauman and Parodi (15) in Argentina. It has also been recorded in lists of smuts collected in different parts of Europe: by Winter (34) in Germany, Schröter (29) in Silesia, Lind (21) in Denmark, Lindau (22) in the Mark Brandenburg, Bubák (7) in Bohemia, Prillieux (28) in France, and Passerini (26) in Italy. The first record of its occurrence in the United States was made by Burrill (8) in 1888. It was reported by Webber (33) in Nebraska in 1889, and by Failyer and Willard (14) in Kansas in 1890. In 1906 Clinton (12) recorded its occurrence in thirteen states, as well as in Ontario, Canada, Jamaica, and Cuba.

Sphacelotheca cruenta was first described by Kühn (17) in 1872. It has been recorded by Winter (34) in Germany; Schröter (29) in Silesia; Bubák (7) in Bohemia; Busse (9) in Tanganyika Territory; Kulkarni (19) in the Sholapur District of the Bombay Presidency; and Butler (10) in the Central Provinces. It was first collected in the United States by Trelease (32) at Madison, Wisc., who, however, incorrectly recorded it as *Sphacelotheca Sorghi*. According to Potter (27) it has been introduced into the United States on seeds of kaoliangs from various parts of China. Its presence in Australia or South Africa has not been noted.

According to the investigations of Kühn (18), Brefeld (3, 4, 5), Clinton (11), Kellerman (16), Butler (10), Kulkarni (19), and others, the two kernel-smuts have a very similar life-history. The infection takes place in the early germination stages of the seedlings and usually from spores adhering to the seed. After penetration of the germ-tube, the young mycelium develops in the embryonic tissue of the host, keeping pace with the latter's development. At the flowering period the ovaries and adjacent parts of the host are converted into the characteristic smut balls. The pathological differences between the two smuts are quite striking and are described below. The spores, however, are very similar in shape and size and germinate in a similar fashion.

The seed of the varieties of sorghum was obtained from a number of different sources. Some of it was secured from seedsmen, but many of the samples were obtained from the Agricultural Experiment Stations of Missouri, Louisiana, Kansas, Oklahoma, and Texas. The writer is especially indebted to Dr. C. R. Ball and Mr. B. E. Rothgeb, Office of Cereal Investigations, and Mr. H. N. Vinall, Office of Forage Crop Investigations, U. S. Department of Agriculture, for the seed of a large number of varieties.

The spores of *Sphacelotheca Sorghi* used for inoculation were collected on kafir, grown in experimental work the previous season. The spores of *Sphacelotheca cruenta* were obtained through the courtesy of Mr. S. L. Ajreker, Poona Agricultural College, Poona, India.

Sufficient seed for planting the rows was placed in separate packets and one set of the varieties was inoculated by dusting heavily with the spores of *Sphacelotheca Sorghi,* and the other set inoculated in the same fashion with the spores of *S. cruenta.* Special care was taken not to mix the two smuts either during the operation of inoculation or subsequent planting. Due to poor germination of the seed only a few plants of some strains or varieties were obtained. In most cases, however, a fair number of plants grew to maturity.

DISCUSSION AND COMPARISON OF RESULTS

As will be noted from an examination of the table, varieties belonging to all the seven main groups of sorghum (broom corn,

VARIETAL RESISTANCE OF SORGHUMS TO SPHACELOTHECA SORGHI (LINK) CLINTON AND SPHACELOTHECA CRUENTA (KÜHN) POTTER

Variety	Seed No.	*Sphacelotheca Sorghi*			*Sphacelotheca cruenta*						
								Comparison of Plants [3]			
								Normal		Infected	
		No. Plants	No. Inf.	Per Cent Inf.	No. Plants	No. Inf.	Per Cent Inf.	No.	Height	No.	Height
Broomcorn, Acme	*180* (*C.I. 243*)	22	6	27.2	26	3	11.5	1	3′–10″	1	3′– 0″
" Standard	*199*	45	4	8.8	35	2	5.8	3	8′– 3″	2	4′– 5″
Durra, Brown	*30*	—	—	—	23	10	43.4	5	6′– 3″	10	5′– 3″
" "	*74*	36	12	33.3	—	—	—	—	—	—	—
Darso	*49*	20	0	0	—	—	—	—	—	—	—
"	*165*	39	0	0	25	6	24.0	10	4′– 4″	6	3′– 9″
"	*225* (*Tex. Sta. 2897*)	22	0	0	20	13	65.0	7	3′–11″	13	3′– 3″
"	*234* (*C.I. 615*)	23	0	0	—	—	—	—	—	—	—
Feterita	*182* (*C.I. 182*)	39	0	0	—	—	—	—	—	—	—
"	*222* (*F.C.I. 2157*)	30	0	0	39	0	0	—	—	—	—
" , Spur	*151* (*Tex. Sta. 3232*)	9	0	0	—	—	—	—	—	—	—
" "	*183* (*C.I. 623*)	37	0	0	36	0	0	—	—	—	—
" "	*226* (*Tex. Sta. 3232*)	10	0	0	15	0	0	—	—	—	—
Hegari, Dwarf	*84*	9	0	0	6	0	0	—	—	—	—
" "	*148* (*S.P.I. 34911*)	5	0	0	—	—	—	—	—	—	—
Kafir, Blackhull	*153* (*F.C.I. 2036*)	3	3	100	—	—	—	—	—	—	—
" "	*184* (*C.I. 204*)	20	8	40	23	5	21.7	11	3′– 4″	5	2′– 4″
" "	*185* (*C.I. 71*)	40	12	30	47	9	19.1	14	4′– 5″	9	4′– 0″
" "	*223* (*F.C.I. 2165*)[4]	67	20	29.8	85	12	14.1	19	4′– 9″	11	4′– 0″
" "	*223* " "[5]	172	73	42.4	113	39	34.5	61	3′– 0″	39	2′– 1″
" "	*227* (*Tex. Sta. 6022*)	37	8	21.6	37	5	13.5	5	4′– 2″	5	4′– 3″
" Dawn	*154* (*F.C.I. 1932*)	22	4	18.1	—	—	—	—	—	—	—
" "	*186* (*C.I. 340*)	37	16	43.2	47	13	27.6	23	3′–10″	9	3′– 1″
" "	*228* (*Tex. Sta. 673*)	6	3	50.0	24	5	20.8	15	3′– 9″	5	3′– 5″
" Pink	*155* (*F.C.I. 1930*)	26	9	34.6	17	5	29.4	7	4′– 7″	5	3′– 8″
" " (Late)	*156* (*F.C.I. 9439*)	12	1	8.3	—	—	—	—	—	—	—

[3] For various reasons not all of the plants in the rows were measured.

VARIETAL RESISTANCE OF SORGHUMS TO SPHACELOTHECA SORGHI (LINK) CLINTON AND SPHACELOTHECA CRUENTA (KÜHN) POTTER

Variety	Seed No.	*Sphacelotheca Sorghi*			*Sphacelotheca cruenta*						
								Comparison of Plants [3]			
								Normal		Infected	
		No. Plants	No. Inf.	Per Cent Inf.	No. Plants	No. Inf.	Per Cent Inf.	No.	Height	No.	Height
" Red	*157 (S.P.I. 19749)*	10	0	0	19	10	52.6	6	4′– 1″	10	3′– 3″
" "	*188 (C.I. 34)*	27	2	7.4	32	10	31.2	10	4′– 7″	10	3′–11″
" "	*229 (Tex. Sta. 46)*	18	2	11.1	12	1	8.3	—	—	—	—
" Sunrise	*189 (C.I. 472)*	45	10	22.2	38	6	15.7	11	6′– 6″	6	5′– 2″
Kafirita	*235 (C.I. 548)*	34	0	0	—	—	—	—	—	—	—
Kaoliang, Barchet	*190 (C.I. 310)*	27	0	0	19	1	5.2	11	5′– 6″	1	5′–10″
" Brown	*158 (S.P.I. 38463)*	12	0	0	—	—	—	—	—	—	—
" Dwarf	*121 (C.I. 293)*	33	0	0	31	0	0	—	—	—	—
" Manchu	*119 (C.I. 328-1)*	33	1	3.3	—	—	—	—	—	—	—
" "	*191 (C.I. 171)*	37	7	18.9	33	9	27.2	13	7′–11″	9	5′– 4″
" Valley	*192 (C.I. 309)*	34	13	38.2	32	6	18.7	18	7′– 0″	5	4′– 9″
Milo, Dwarf	*159 (F.C.I. 1933)*	6	0	0	—	—	—	—	—	—	—
" "	*193 (F.C.I. 332)*	38	0	0	33	0	0	—	—	—	—
" "	*224 (F.C.I. 2158)*	27	0	0	32	0	0	—	—	—	—
" "	*231 (Tex. Sta. 670)*	29	0	0	34	0	0	—	—	—	—
" Standard	*194 (C.I. 234)*	28	0	0	—	—	—	—	—	—	—
" White	*160 (F.C.I. 5886)*	21	0	0	16	0	0	—	—	—	—
" Dwarf White	*205*	25	0	0	18	0	0	—	—	—	—
Shallu	*161 (Agrost. 2650)*	4	1	25.0	18	10	55.5	7	5′–11″	10	4′– 5″
"	*230 (Tex. Sta. 1653)*	34	2	5.8	42	2	4.7	—	—	—	—
Sorgo, Black Amber	*162 (F.C.I. 7038)*	34	7	20.5	47	8	17.0	9	7′– 5″	8	5′– 8″
" Gooseneck	*233 (Agrost. 2652)*	21	5	23.8	21	3	14.2	—	—	—	—
" Orange	*135 (C. I. 113a)*	27	10	37.0	17	7	41.1	6	7′– 1″	7	5′– 3″
" "	*169 (F.C.I. 2025)*	14	4	28.5	12	0	0	—	—	—	—
" Red Amber	*232 (S.P.I. 17548)*[4]	31	9	29.0	36	7	19.4	7	6′– 7″	5	5′– 7″
" " "	*232 (" 17548)*[5]	31	12	38.7	39	12	30.7	—	—	—	—
" Sumac	*139 (F.C.I. 1831)*	64	26	40.6	110	19	17.2	29	6′– 6″	11	5′– 0″
Sudan Corn	*197*	21	0	0	—	—	—	—	—	—	—

[4] Planted May 23.
[5] Planted July 12.

durra, kafir, kaoliang, milo-feterita, shallu, and sorgo) were inoculated with *Sphacelotheca Sorghi*. In addition, certain sorghums, whose exact classification has not been determined, such as darso, hegari, and kafirita, were grown. Several of the strains were not included in the series with *S. cruenta*, but practically all of the varieties were represented.

The results with *Sphacelotheca Sorghi* correspond very closely to those obtained previously. The varieties of broom corn, durra, kafir, shallu, and sorgo proved to be quite susceptible. As a rule, however, the percentages of infection were not so high as those secured in previous years. In a few cases negative results were obtained with varieties or strains which in the past have been readily infected. On the other hand, darso, feterita, kafirita, milo, and Sudan corn have proved to be entirely free from infection, results in harmony with those previously obtained. Comparatively low percentages of infection, or even negative results, were secured with several kaoliangs—Barchet, Brown, and Manchu (*119*). On the other hand, Manchu (*191*) and Valley kaoliang gave relatively high percentages of infection. Dwarf kaoliang remained entirely free from infection as in previous years.

The results with *Sphacelotheca cruenta* show a close correspondence with those obtained with *S. Sorghi*. With the loose kernel-smut, positive results were obtained with the varieties and strains of broom corn, kafir, durra, shallu, and sorgo. Negative results were secured with feterita, milo, Dwarf hegari, and Dwarf kaoliang. The other kaoliangs grown were infected. Usually somewhat lower percentages of infection were obtained than with *S. Sorghi*. Higher percentages, however, were secured with Brown durra, Red kafir (*157* and *188*), Barchet kaoliang, Manchu kaoliang (*191*), and Shallu (*161*).

The most striking difference between the infecting capacities of the two smuts occurred in the case of darso. Four strains of this sorghum were grown in the series with *Sphacelotheca Sorghi*. Out of a total of 104 plants, none were infected. In previous years darso has also consistently shown freedom from infection with this smut. On the other hand, two of these strains were grown in the series with *S. cruenta*, and both gave a considerable

number of infected plants. Out of a total of 45 plants of both strains, 19 were infected.

The results with Dwarf milo differ entirely from those obtained by Kulkarni (20). As already noted, he states that he secured fifty infected heads out of a total of 645, a percentage of infection of 7.8 per cent. In the course of the present experiments, 99 plants of Dwarf milo belonging to three different strains were grown and none of them were infected.

DIFFERENCES IN THE PATHOLOGICAL EFFECTS OF THE TWO KERNEL-SMUTS OF SORGHUM

Sphacelotheca Sorghi and *S. cruenta* produce quite different effects on the host plants, which may be compared as follows:

1. One of the most obvious differences observed was in the date of emergence of the heads of normal and infected plants. Plants infected with *Sphacelotheca Sorghi* headed out at the same time as normal plants. On the other hand, plants infected with *S. cruenta* headed out very much earlier than the noninfected plants. Practically all of the heads of the smutted plants had fully emerged before any normal heads appeared in the row. Brefeld (3, 4) first called attention to this fact in connection with his experiments with this smut.

2. There was no difference observed in the height of plants infected with *Sphacelotheca Sorghi* as compared with the normal plants. In one or two cases exact measurements were made, but no differences were found. Certainly, as one observed the rows of plants, the infected plants were fully as tall as the normal.

In the case of *Sphacelotheca cruenta* the difference was very striking. Almost invariably the infected plants were 6 inches to a foot or more shorter than the normal. In the table the measurements of both normal and infected plants are given. Normal plants of durra average a foot taller than the infected plants, normal plants of darso 6″–8″ taller, normal plants of the various kafirs 6″–12″ taller, normal plants of kaoliangs 2 feet or more taller, normal plants of shallu 1½ feet taller, normal plants of sorgos 1–2 feet or more taller. In only a few cases did the infected plants average as tall or taller than the normal.

3. In general appearance, the plants infected with *Sphacelotheca Sorghi* resembled the normal plants. On the other hand, plants infected with *S. cruenta* showed a marked tillering and branching. In many cases an unusual number of tillers originated at the ground level, and there was also an increased development of side branches on the main stem. Consequently, young, smutted heads appeared from lateral branches during the growing season. There was, of course, some branching in the case of plants infected with *S. Sorghi,* but this did not seem to differ in any way from the normal plants.

4. Plants infected with *Sphacelotheca cruenta* sometimes showed a marked enlargement of the glumes. This was particularly the case in the Brown durra. On the other hand, *S. Sorghi* does not seem to produce any change of this character in any variety of sorghum. (See pl. 14, figs. 1 and 9.)

5. The heads infected with *Sphacelotheca Sorghi* are compact and about the same size as the normal, or even larger, due to the increased size of the smut balls as compared with the normal kernels. On the other hand, heads infected with *S. cruenta* are much more slender, with a somewhat looser arrangement than in the case of normal heads. (Compare pl. 14, figs. 1 and 2, and pl. 15, figs. 11 and 12.)

6. The sori of *Sphacelotheca Sorghi* are confined to the flowers. The ovary is converted into the enlarged smut balls. *S. cruenta,* however, may produce sori on the pedicels or other parts of the panicle as well as in the flowers. This has been emphasized as one of the characteristic features of this smut. During the past season, however, a single head of Red Amber sorgo, out of many hundreds of heads observed, showed sori on the pedicels or branches of the panicle.

7. The smut balls of *Sphacelotheca Sorghi* are more or less conic and possess a comparatively thick, tough membrane, which persists for a considerable period and which stands a great deal of weathering. The smut balls of *S. cruenta* are much longer, more slender, and cylindric in shape. They also break open very readily and permit the distribution of the spores. This rupturing of the membrane occurs even before the smut ball has completely emerged

from the glumes. The membrane is light-grayish in color and is very thin and delicate. It is composed of nearly spheric cells, which are much larger than the spores and which readily separate from each other. The cells of the membrane of *S. Sorghi* are smaller, somewhat elongated, and adhere together. (Compare pls. 14 and 15.)

8. The central columellae of the smut balls of *Sphacelotheca cruenta* are much longer, more slender, and curved than those of *S. Sorghi*. Due to the early dissemination of the spores in the field they are quite conspicuous on the maturing plants. (Pl. 14.)

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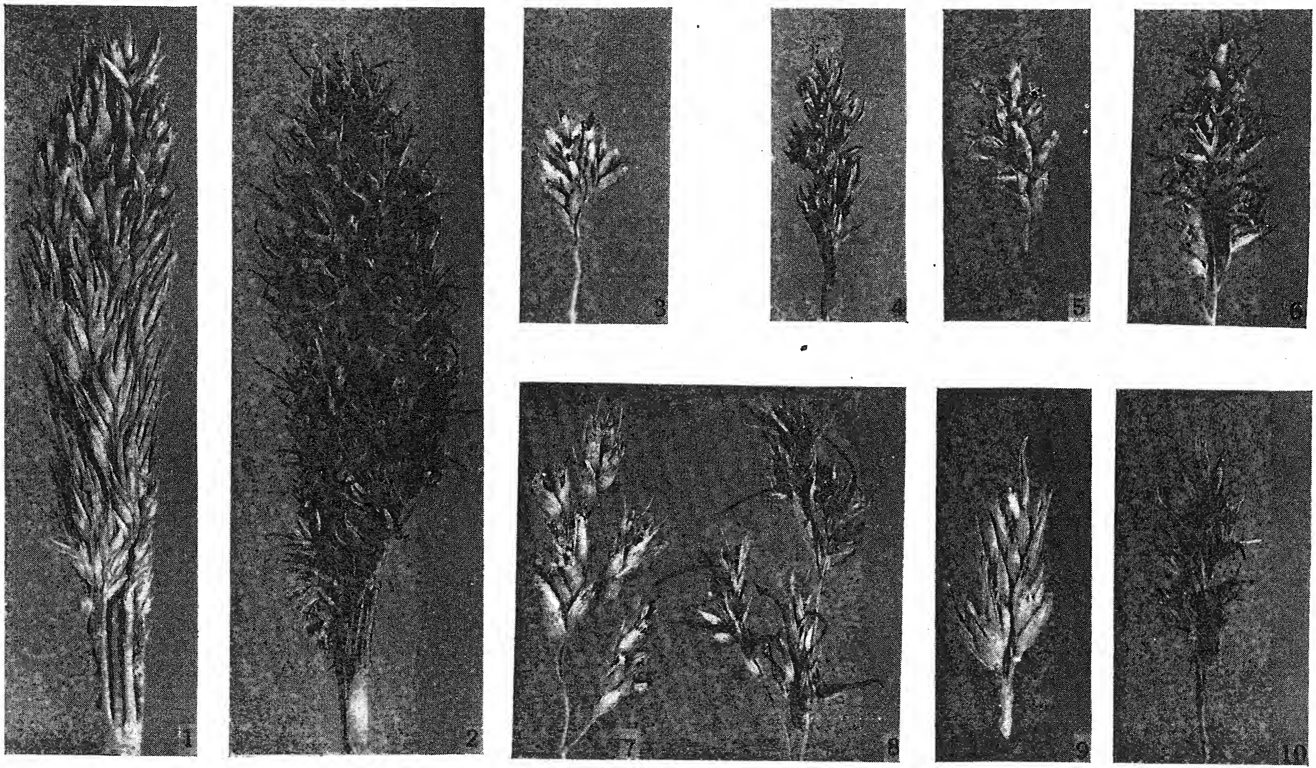
BROOKLYN BOTANIC GARDEN.

EXPLANATION OF PLATES

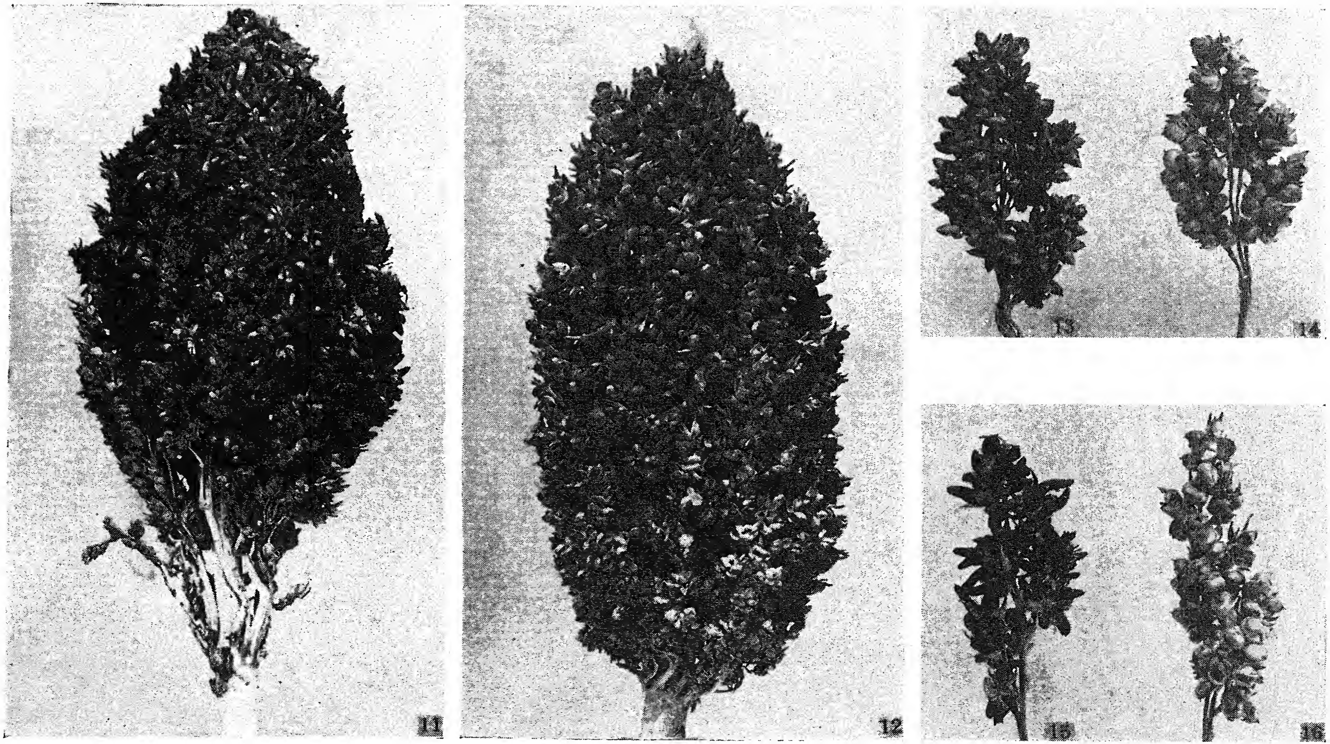
PLATE 14

FIG. 1. *Sphacelotheca cruenta.* Infected head of Brown durra. Smut balls emerging between enlarged glumes. 4/5 nat. size.

FIG. 2. *S. cruenta.* Infected head of Brown durra. Late stage, spores largely disseminated and columellae visible. 4/5 nat. size.



Sphacelotheca cruenta (Kühn) Potter



SPHACELOTHECA SORGHI (LINK) CLINTON

Fig. 3, 4. *S. cruenta.* Darso, early and late stages. 4/5 nat. size.

Fig. 5, 6. *S. cruenta.* Black Amber sorgo, early and late stages. 4/5 nat. size.

Fig. 7, 8. *S. cruenta.* Shallu, early and late stages. 4/5 nat. size.

Fig. 9, 10. *S. cruenta.* Brown durra, early and late stages. 4/5 nat. size.

PLATE 15

Fig. 11. *S. Sorghi.* Infected head of Brown durra. 1/2 nat. size.

Fig. 12. *S. Sorghi.* Normal head of Brown durra. 1/2 nat. size.

Fig. 13. *S. Sorghi.* Branch of infected head of Brown durra. 2/3 nat. size.

Fig. 14. *S. Sorghi.* Branch of normal head of Brown durra. 2/3 nat. size.

Fig. 15. *S. Sorghi.* Branch of infected head of Dawn Kafir. 2/3 nat. size.

Fig. 16. *S. Sorghi.* Branch of normal head of Dawn Kafir. 2/3 nat. size.

NOTES AND BRIEF ARTICLES

(*Unsigned notes are by the editor*)

A bibliography of fungous insects and their hosts, compiled from American literature by H. B. Weiss, appeared in *Entomological News* 32: 45–47. 1921.

Mosaic diseases are discussed at length by B. T. Dickson in Technical Bulletin 2 of Macdonald College, which contains over 100 pages of text, an extensive bibliography, and several plates of illustrations.

An article on phosphorescent woods, by D. Bois, appeared in *Jour. Soc. Nat. Hort. France* **21**: 392–395. 1920. The various fungi causing phosphorescence (luminescence) are there discussed and their distribution given.

In a recent paper in the *Transactions of the British Mycological Society*, Professor Buller describes and discusses the basidial and oidial fruit-bodies of *Dacryomyces deliquescens*, the oidial stage of which has been generally known as *Dacryomyces stillatus* Nees.

In an article by A. S. Rhoads in *Phytopathology* for October, 1921, *Collybia velutipes* and *Pleurotus ostreatus* are reported as serious wound-parasites on *Lupinus arboreus* in California; infection being largely due to tunnels made in the stems of this shrub by the larvae of a moth.

A long and abundantly illustrated paper by F. L. Stevens on the Helminthosporium foot-rot of wheat, with observations on the morphology of this genus of fungi and the occurrence of saltation in it, appeared in the *Bulletin of the Illinois Natural History Survey* for June, 1922.

An unknown disease of elms in Holland has been causing much damage to practically all the species and varieties of this tree used on city streets. Several fungi have been isolated, but no organism has been definitely connected as yet with the disease and no control measures have been suggested.

A new fungous enemy of the pepper tree, grown extensively in the Southwest for ornament, was recently described by J. G. Brown in *Science* as *Inonotus Schini*. This fungus enters through cracks and wounds made by frost, wind, and improper pruning. It causes decay in the trunk and finally kills the tree.

Ringworm of the nails in the southern United States is reported by R. S. Hodges to be due to a small-spored ectothrix (a species of *Trichophyton*) and to *Trichophyton rubrum*. About 1 in every 500 of the population there have this disease, which seems to appear first in the form of eruptions on the hands and feet.

According to C. D. Girola, considerable damage is done to fruit and forest trees in the Argentine by *Ganoderma sessile*, which is distributed by the spores gaining access to wounds or by the mycelium spreading from diseased to healthy roots. Several recommendations are made regarding the best methods of controlling this disease.

A number of avocado diseases are discussed by H. E. Stevens in *Fla. Sta. Bull.* 161: 3–23. 1922, and recommendations made for controlling them. Bordeaux mixture is said to be effective in the case of scab (*Cladosporium*), black spot (*Colletotrichum*), blotch (*Cercospora*), and rusty blight (*Gloeosporium*), but lime-sulphur solution is suggested for the powdery mildew (*Oïdium*).

In response to requests for specimens of myxomycetes found in the Cayuga Lake Basin, F. B. Wann and W. C. Muenscher have begun to issue ten sets of "North American myxomycetes," distributed among herbaria at Washington, Cincinnati, Albany, Pitts-

burgh, Madison, Ithaca, Toronto, Cambridge, Berkeley, and London (England). A list of the fifty species in the first set appeared in *Mycologia* for January, 1922.

I have before me two recent bulletins on wildfire of tobacco, one from the Connecticut Experiment Station by Clinton and McCormick and the other from the North Carolina Experiment Station by Wolf. Also a bulletin on blackfire, or angular leaf-spot of tobacco, by Fromme and Wingard, of the Virginia Experiment Station. This latter disease is caused by *Bacterium angulatum,* an organism described by Fromme and Murray in 1919.

A foot-rot of rhubarb caused by a variety of *Phytophthora parasitica* is described, discussed, and abundantly illustrated in an article by G. H. Godfrey in the *Journal of Agricultural Research* for Jan. 6, 1923. This disease has been found in Maryland and Virginia, and is probably much more widely distributed. It rapidly and completely destroys its host, especially in warm, moist weather; but may be controlled to a degree by the use of Bordeaux combined with careful sanitary measures.

A valuable professional paper by N. O. Howard on the control of sap-stain, mold, and incipient decay in green wood appeared toward the end of 1922 as Bulletin 1037 of the U. S. Dept. of Agriculture. It contains over 50 pages of text, many text-figures, and a long bibliography. Care in the selection of raw stock, quick drying, ample ventilation, and steam treatment or antiseptic dips in special cases are recommended as preventive measures. Neither molds nor staining fungi appear to affect the strength of timber.

The white heart-rot of black locust, caused by *Trametes robiniophila,* is the subject of a paper contributed by Kauffman and Kerber to the *American Journal of Botany* for November, 1922. This article, which raises more questions than it answers and may therefore stimulate further research, includes a discussion of the macroscopic and microscopic characteristics of the rot, its mode of

advance, the distribution of the mycelium in the various portions of the affected trunk, and its effect on the various elements of the wood.

The germination and growth of fungi at various temperatures and in various concentrations of oxygen and of carbon dioxide is discussed by W. Brown in the *Annals of Botany* 36: 257–283. 1922. The author concludes, on the basis of various investigations, that the gas storage method is most effectively used in combination with the ordinary cold storage method, and that it will give the best results when no attack of the fruit has begun previous to storage, and when conditions are such that a minimum of nutrient is available for spores on the surface of the fruit.

The development of the Geoglossaceae is discussed at length in a valuable illustrated paper by G. H. Duff in the *Botanical Gazette* for November, 1922. A very close correspondence appears to exist in the history of the fertile systems of the Geoglossaceae and of certain disco-lichens of the *Baeomyces* group, which, in addition to the Helvellinean veil, seems good evidence of relationship. The progress of evolution in these plants, according to the author, has been from a type in which fertilization took place through the agency of the trichogyne, and has been marked by a gradual reduction of the sex organs.

Observations on two poplar cankers in Ontario, by E. H. Moss, appeared in *Phytopathology* for September, 1922. *Cytospora chrysosperma* and *Dothichiza populea* are said to occur rather commonly in southern Ontario, and, according to the author, the latter disease has existed on this continent for a considerable period of time. Older trees of certain species of *Populus* commonly planted are rendered unsightly and are gradually killed by these two fungi. Younger trees of *P. deltoides,* especially if seriously injured or weakened, are likely to succumb to the attacks of *C. chrysosperma,* and infected nursery stock of *P. italica* is rapidly killed by *D. populea.*

In Spaulding's recent monograph on the white pine blister rust, the Asiatic origin of this very important disease seems to be established, with a number of interesting facts regarding its life-history. The aeciospores from the overwintered mycelium in the pine bark are the chief source of infection, these spores being capable of attacking leaves of *Ribes* after having been blown several miles. The uredospores perish much more quickly, while the sporidia can carry infection only 100 to 600 yards. Unfortunately, this rust has appeared in the great pine forests of the Northwest, where the valuable stands of *Pinus monticola* and *P. Lambertiana* are now directly threatened.

The effect of external and internal factors on the germination of fungous spores has been studied by W. L. Doran, who contributed an article on the subject to the *Torrey Bulletin* for November, 1922. After experimenting with a number of species, the author concluded that the spores of parasite fungi germinate better when obtained from the living host than when obtained from artificial media; that freshly matured spores can germinate through a broader range of environmental conditions than can old spores; and that longevity of spores is dependent on conditions of storage after detachment from the host, moisture being of more importance than temperature.

The North American species of *Clavaria* are treated by Burt in his usual excellent style in the *Annals of the Missouri Botanical Garden* for February, 1922, which appeared in August. Ninety-eight species are included, many of them being figured on the eleven closely crowded plates. Species described as new are: *Clavaria pinicola*, from Idaho; *C. flavuloides*, from New York, known by Peck as *C. subtilis* Pers.; *C. mutans*, from New York, known by Peck as *C. Krombholzii*; and *C. pilosa*, from Porto Rico. The following species are excluded from the genus: *C. ornatipes*, *C. subcorticalis*, and *C. vestipes*, transferred to *Lachnocladium*; *C. tenax* to *Tremellodendron*; and *C. typhuloides* to *Pistillaria*. A few exotic species are also discussed.

A brief paper on the mycorhizas of coniferous trees, by W. B. McDougall, appeared in the *Journal of Forestry* for March, 1922. The specimens on which this paper was based were collected by Mr. Barrington Moore at Bar Harbor, Maine, in October, 1921, and forwarded at once in a fresh condition to the author, who made several interesting notes upon them. In his conclusion, he says: "It was formerly believed that the ectotrophic mycorhizal fungi were of considerable benefit to the host plants in that they aided them in absorbing materials from the soil and this old idea is still retained in many, even of the latest, botanical text-books. There is no evidence in favor of such a hypothesis, however, and it is the consensus of opinion among recent workers on these structures that the fungi are merely parasitic on the roots of the higher plants, and that the higher plants receive no benefit at all from the association."

Citrus scab is the subject of a professional paper by J. R. Winston, published on Jan. 26, 1923, as Bulletin 1118 of the U. S. Dept. of Agriculture. This widely distributed citrus disease of foreign introduction is, according to the author, second in importance to melanose and stem-end rot caused by *Phomopsis Citri*. It is considered the most serious fungous disease of the citrus nursery, where it attacks leaves and succulent twigs. In the orchard its activity is mainly confined to fruit and leaves. Young grapefruits are extremely susceptible to infection immediately after the falling of the petals, but they become progressively resistant until they reach immunity at a diameter of about three fourths of an inch. Citrus scab is caused by a definite fungus, usually but erroneously referred to as *Cladosporium Citri* Massee, although it has none of the characters of *Cladosporium* Link. Plain Bordeaux mixture as well as Bordeaux with oil emulsion is very effective against this disease, either in the nursery or in the orchard.

Professor Fitzpatrick went to Minneapolis early in the year and attended to the shipment of the Durand library and herbarium to Cornell University. In reply to a query regarding this immensely important collection, he wrote me under date of Feb. 22 as follows:

"This collection has now reached us safely, though as yet it has not been unpacked. It includes 12,000 specimens of discomycetes and 6,000 carefully prepared slides, many of which represent mounts made from type specimens by Durand in various institutions of this country and abroad. The specimens are completely indexed and are accompanied by Dr. Durand's personal notes on them. The collection was obtained in the cases and will be retained as a unit in the shape in which Dr. Durand left it. The library contains about 200 books chiefly on discomycetes and about 5,000 separates. This herbarium and the Atkinson herbarium will be housed in the plant pathology department, but will be kept as units, and will not be added to as the years pass. The plant pathology herbarium here will be the growing herbarium."

SULLIVANT'S OHIO FUNGI

A number of the fungi collected in the vicinity of Columbus, Ohio, by Sullivant and sent to Montagne in Paris for study have not been identified by American collectors since Sullivant's time. In publishing my recent papers on dark-spored agarics, a few notes made at Paris in 1913 escaped my attention. They are of no great value without further comparison of specimens, but may help some student who has the opportunity to work with fresh plants in the region where Sullivant collected. The notes are given as I made them at the time.

Agaricus (*Hypholoma*) *comaropsis* Mont. Syll. Crypt. 122. 1856. Very young, small, conic, with long stipe, growing in loam. Might be some young *Hypholoma,* but entirely unrecognizable.

Agaricus foederatus Berk. & Mont. Syll. Crypt. 121. 1856. Columbus, Ohio, *Sullivant 87*. Cespitose in moss and soil, but probably from buried wood. It is a species of *Hypholoma* and what else but *H. lacrymabundum* or *H. perplexum*? The spores must be compared, however. It seems less firm than *H. perplexum,* but the specimens are old. I did not find it at Kew.

Agaricus (*Psathrya*) *pholidotus* Mont. Syll. Crypt. 126. 1856. Columbus, Ohio, *Sullivant 29*. This is in shape for comparison. It is similar to *Hypholoma Candolleanum* and *H. pelianthum,* according to Montagne, but the spores are bay-fuscous.

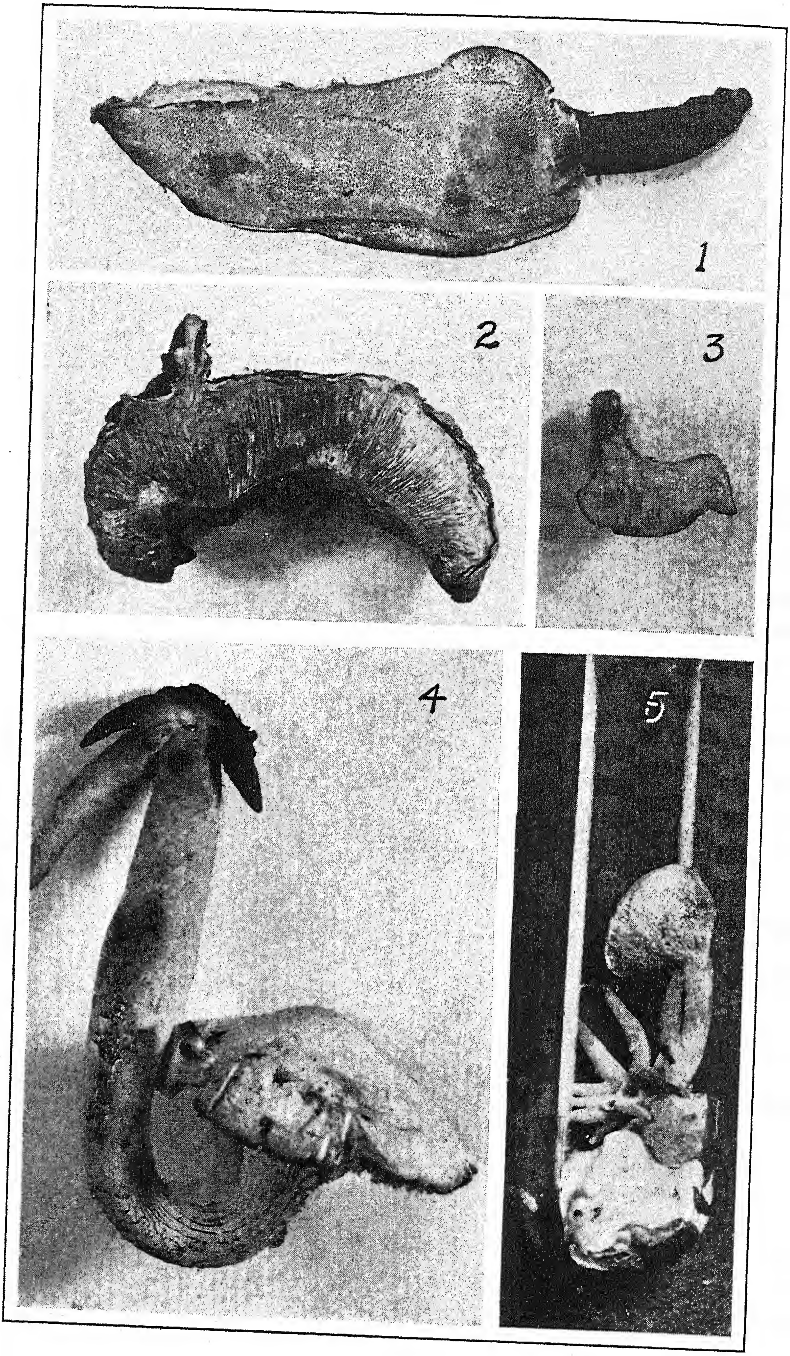
Agaricus falcifolius Mont. Syll. Crypt. 127. 1856. Columbus, Ohio, *Sullivant 9*. Lots of it in clusters on bark, well preserved. About the shape of *Coprinus micaceus,* but without glistening scales. Placed by Saccardo in *Psathyrella.*

Agaricus puliculosus Mont. Syll. Crypt. 124. 1856. Placed in the genus *Psilocybe* by Saccardo. Specimens collected on the ground at Columbus, Ohio, by Sullivant. Types pretty well preserved and can be compared.

Agaricus rhodophaeus Mont. Syll. Crypt. 124. 1856. Collected among fallen leaves at Columbus, Ohio, by Sullivant. Specimens fairly well preserved and can be compared. Saccardo places it in *Psilocybe.*

Agaricus Sullivantii Mont. Syll. Crypt. 123. 1856. On naked ground near Columbus, Ohio, *Sullivant 258.* Apparently *Hypholoma velutinum.* It is large and shaggy with a large stipe. Saccardo places it in *Psilocybe.*

W. A. MURRILL



1–3. Trametes serialis
4. Lentinus lepideus
5. Lentinus tigrinus

MYCOLOGIA

VOL. XV JULY, 1923 No. 4

OCCURRENCE AND IDENTITY OF COTTON MILL FUNGI

WALTER H. SNELL

(WITH PLATE 16)

A previous paper of the writer's (8) dealt with studies upon the physiology of five structural timber-destroying fungi important in the decay of cotton mill weave shed roofs. The present paper gives further observations upon the occurrence of fungi within cotton mills and upon the identity of those which are primary agents in the decay of the mill timbers, with additional notes on the cultural characters of certain of them.

MYXOMYCETES

It is to be expected that myxomycetes should be found in the weave sheds and dye houses of cotton mills where the humidity is high. *Fuligo ovata* (Schaeff.) Macbr. has often been found both on badly decayed wood, which was quite moist, and the painted surfaces of apparently sound wood. Of much more common occurrence, however, is *Stemonitis fusca* (Roth) Rost. This plant has been collected upon newly built roofs and basement ceilings, old roofs, and upon newly painted roofs. In one new warehouse not quite finished this species of *Stemonitis* occurred in large quantities on the ceiling of the basement and four floors above it. It grew mostly in the angles between the beams and the flooring, in hundreds of clusters, some of which were several inches long. The presence of so much growth in a structure not quite finished

[MYCOLOGIA for May (15: 107–151) appeared May 31, 1923]

was the cause of no little concern to the contractor, who knew only that "fungus" caused him much loss and trouble.

Another myxomycete of rather rare occurrence anywhere, *Reticularia lycoperdon* Bull.,[1] was found on the roof of one weave shed. The fructifications occurred literally by hundreds on the yellow pine rafters and roof planks, most commonly in the angles between the two. The ashy gray, more or less globular fruit bodies were not very conspicuous against the dusty white paint, but where the peridia of old ones had disappeared there was a dark brown blotch made by the spores. These peridia are very delicate and when they are broken the brown spores drop out in spoonsful, like cocoa. One interesting fact in connection with the occurrence of these plants was that they were found only upon one half of the weave shed roof. The shed was about 300 feet wide, pitched in the middle with the drains at either side. The pitch ran north and south parallel to a body of water to the east. This myxomycete occurred only on the west half. It would seem that this half of the roof must have been the moister of the two, but what factor made it moister than the east half was not determined.

PENIOPHORA

Two species of *Peniophora* are collected occasionally in mills. *P. pubera* (Fr.) Sacc.[2] is found on badly decayed wood and usually on wood that is very moist, even dripping with water. Out of doors it is usually found upon frondose wood, but it occurs on spruce and hard pine in mills.

Peniophora gigantea (Fr.) Mass[3] has thus far been seen more particularly on hard pine beams in cotton warehouses. It is very common in old warehouses and has been found in new ones upon hard pine sapwood that was discolored from long storage out of doors. Timbers showing this fungus have probably always become infected in storage. In one warehouse in particular, the basement of which had been flooded all summer, nearly every beam was infected with this fungus, some of the patches being several

[1] This plant was identified by Dr. C. G. Lloyd.

[2] The writer is grateful to Dr. E. A. Burt for the identification of this fungus.

[3] The identification was confirmed by Dr. Burt.

square feet in area. The contractor was just completing the structure and was much worried at the appearance of this extensive growth.

CONIOPHORA CEREBELLA Pers. and MERULIUS LACRYMANS Wulf. ex Fr.

Coniophora cerebella Pers. has been found occasionally in mills, either in basements or on upper floors, but not thus far on weave shed roof planks, where conditions are apparently not favorable for its growth and reproduction. That this factor is not temperature seems probable, because the optimum for the species is 26° C. and the inhibiting point 36° C.—only a little lower than the same points for any of the fungi which do grow on weave shed roof planks. It is possible that the factor may be moisture, because it has been noted in flask cultures that most of the growth of *C. cerebella* occurs in the upper half of the flask, which is, of course, drier, and almost none in the lower or moist half.

A species of *Merulius* determined, where determination was possible, to be *M. lacrymans* Wulf. ex Fr. has been found quite often in similar locations and especially in cotton ware- and storehouses. It is very destructive to floorings near the ground and beams resting upon masonry. It is also found often in the wood work around valve pits, where during the summer a great deal of moisture is present. Strands and mycelial mats have been found in some cases covering several square yards of brick work in such places, spreading to all the near-by wood material. It has also got into baled cotton occasionally and rotted the cotton on the ends of the bales quite extensively. The mycelium, at first white, turns yellow in the latter part of the summer and forms fruiting surfaces during the latter part of September and in October.

LENZITES SEPIARIA Fr.

The importance of this fungus in the decay of mill roofs has not been properly emphasized. The opinion was some time ago expressed by F. J. Hoxie that *L. sepiaria* Fr. and *L. trabea* Pers. ex Fr. were responsible for the greater part of the decay of cotton mill roofs. It certainly appears as if this were true, for some of

the other fungi responsible for the more spectacular and better known instances of decay are of much rarer occurrence. A good number of the more ordinary cases of roof decay are caused by *L. sepiaria.* Sporophores of this fungus occur quite commonly on mill roofs, growing in the cracks between the planks. They are formed from spring to fall, but not during the winter. While the temperature within the mills is high all the year around, the roof itself is cool enough in the winter time to prevent fructification. The sporophores are usually not pileate, but occasionally so, and are normal in color for the species. The hymenium may be lamellate, daedaloid or poroid, or irpiciform if growing in too wet wood. The spores are quite often smaller than those from fruit bodies collected out of doors. They have been found to measure 6–9 x 2.5–3 μ (mostly 6–7 x 3 μ) as against 8–12 x 2.5–4 μ given by most mycologists.

The cultures of the various isolations of this fungus vary. The first one used (8, pp. 19 and 22) produced either a sodden growth with no superficial mycelium or only a meager superficial growth. On wood it grew in a similar manner, developing little superficial mycelium which formed oidia. Another culture of *L. sepiaria* obtained from spores collected in a mill grew differently. On agar [4] it has occasionally produced the sodden growth, but more often a thick development of superficial mycelium. On wood it has produced an abundant superficial growth with large wads of mycelium which is at first white and may become the characteristic sepia color. On the walls of the flasks a concentric growth often appears.

LENZITES TRABEA Pers. ex Fr.

Lenzites trabea is of more common occurrence in mills than has been supposed (8, p. 4), the writer having thus far found it nearly as often as *L. sepiaria.* *L. trabea* is normally thought of as growing on hardwoods, although it is known to occur on both hardwoods and conifers as does *L. sepiaria.* The writer has found both species side by side on both poplar and pitch pine pulp bolts. On mill roofs it has thus far been collected only on spruce.

Some flask tests were run to test the ability of *L. trabea* to attack

[4] 3 per cent agar, 2½ per cent malt, + 8 Fuller scale—not adjusted.

various conifers and hardwoods, in comparison with other species of fungi, more particularly *L. sepiaria*. The methods were those described by Humphrey (5). These tests (Table I) showed that *L. trabea* was in no wise inferior to *L. sepiaria* and the other mill roof fungi in decaying coniferous woods, but that it did decay the hardwoods somewhat more readily even than *L. sepiaria,* which is very destructive to these woods under the test conditions.

TABLE I

COMPARISON OF THE ABILITIES OF *Lenzites trabea* AND *L. sepiaria* TO ATTACK WOODS OF CERTAIN CONIFEROUS AND HARDWOOD TREES, AS INDICATED BY PERCENTAGE LOSS OF OVEN DRY WEIGHT AFTER ONE YEAR OF INCUBATION AT ROOM TEMPERATURE

	Lenzites sepiaria, per cent	*Lenzites trabea*, per cent
Cypress (*Taxodium distichum*)	50	43
Port Orford cedar (*Chamaecyparis lawsoniana*)	6	6
Southern yellow pine (*Pinus palustris*)	26	7
Douglas fir (*Pseudotsuga taxifolia*)	13	18
Western yellow pine sapwood (*Pinus ponderosa*)	33	38
Sitka spruce (*Picea sitchensis*)	50	50
Eastern white pine (*Pinus strobus*)	32	25
White oak (*Quercus alba*)	1	3
Chestnut (*Castanea dentata*)	4	12
Norway maple (*Acer pseudoplatanus*)	46	70
Redgum (*Liquidambar styraciflua*)	43	54
Basswood (*Tilia americana*)	28	50
Yellow poplar (*Liriodendron tulipifera*)	45	52

The sporophores of *L. trabea* in mills occur in much the same manner as do those of *L. sepiaria.* They have the color normal to out-of-doors specimens and the same characteristic daedaloid hymenium for the most part, although abortive forms occur on very wet wood. The spores measure 7–8 x 2.5–4 μ. The cultures of *L. trabea* have already been described (*loc. cit.*), being characterized by both oidia and chlamydospores and a light ochraceous buff color when mature or when immature if taken from decayed wood.

Lenzites trabea fruits in mills at the same time as does *L. sepiaria.* The two species can readily be distinguished by their sporophores and by their cultures.

TRAMETES SERIALIS Fr.

Exact statements as to the occurrence and identity of *Trametes serialis* Fr. are difficult to make at the present time. In the first place, the limits of the species are variously interpreted by mycologists. In the second place, within mills there are so many abnormal fungus growths, most of them white, that it is difficult to say how much of the decay is due to *T. serialis* under any interpretation of the species. These growths vary from the thin resupinate fructifications of *T. serialis* to large rounded masses with or without pores. These latter forms are white, farinaceous, and have a bitter quinine taste. These characters immediately suggest *Fomes officinalis* Vill. (*F. laricis* Jacq.), but typical *Trametes serialis* has the same appearance and taste. The writer has been able to get the quinine taste from nearly all the specimens of *T. serialis* tested. If *Fomes officinalis* does occur in mills, it is the only one of the important heart rotting fungi to be found fruiting within buildings. The matter can readily be tested by cultures, as cultures of the two fungi are entirely different (Faull, 3, and Snell, 8, pp. 20 and 23).

Trametes serialis occurs more often in moist basements than upon weave shed roofs, although two cases of severe decay have recently been proved definitely to be caused by this species.[5] Plate 16 shows fruit bodies collected in one of the mills in early June, 1921.

TRAMETES CARNEA Nees ex Cooke

In a previous paper (*loc. cit.*) the species here treated was called *Fomes roseus* Alb. & Sch. ex Cooke. There is still some difference of opinion as to the validity of *Trametes carnea* as a species distinct from the former, but some data recently obtained by the writer and about to be published give him reason to believe that the distinction is valid. At all events, the cultures described and used previously were obtained from the thin annual form and not the thick woody perennial form. This fact should be borne in mind. In the bulletin referred to, then (8), the writer would change *Fomes roseus* to *Trametes carnea.*

Neither *Fomes roseus* nor *Trametes carnea* has to the writer's

[5] The identification of the fungus was confirmed by Dr. L. O. Overholts.

knowledge been found inside a weave shed. A form with a pink hymenium has been found on the outside in moist places, such as under eaves, on the ends of rafters and beams, etc., and in moist basements. Whether this fungus is *Fomes roseus* or *Trametes carnea* is not definitely known. Many of the forms found on the under side of rafters and planks were apileate and it was difficult to determine to which species they belonged. Those forms that the writer has seen have been round for the most part (8, pl. II, fig. 5), with a definite lip and quite thick, and because of a similarity between these and forms found on structural timbers elsewhere, which could be definitely determined, the writer would incline to the belief that most of the forms in mills belong to *Fomes roseus*. *Trametes carnea* in similar positions does not form rounded fructifications, but linear ones, and it has no definite lip.

If the species is *Fomes roseus,* as the meager evidence available at present seems to show, it should be emphasized that this fact does not in any way controvert other evidence possessed by the writer and about to be published, relative to different moisture requirements at least, for the fructification of the two species.

The differences between various isolations of *Trametes carnea* and *Fomes roseus* in culture have already been pointed out. In the paper referred to (pp. 20, *et seq.*) one type of *T. carnea* was described. Recently another culture has been used and is much different. It shows very little of the initial soft white mycelial growth and soon forms the tough matted rose-colored tertiary mycelium on both agar and wood. This colored tertiary mycelium does not infect wood very readily, if at all. The delicate white (or secondary) mycelium spreads rapidly from block to block, but the tertiary mycelium apparently has other functions. Inoculation of wood can not be made with the colored mycelium from agar cultures, nor will a block covered with this colored mycelium infect another uninfected block placed beside it. Old wood cultures of the first type remained white and never fruited. The more recent one becomes the characteristic "roseus" color very soon and forms fruit bodies, for the most part apileate, upon agar and the wood blocks.

LENTINUS LEPIDEUS FR. AND LENTINUS TIGRINUS FR.

Lentinus lepideus Fr. and *L. tigrinus* Fr. have both been reported as destructive to mill roofs (8 and 1, respectively). Both of these species may perhaps occur in mills, but all the material examined by the writer has without any doubt been *L. lepideus*. This includes abundant material from Massachusetts mills in one of which one of the most spectacular cases of rot has thus far occurred. In this mill, sheathing on the under side of the rafters formed a series of moist chambers under the entire roof. The roof began to decay after seven years and the sheathing was then removed. Inside were found many abortive fruit bodies of the type formed by *Lentinus lepideus* in the dark (Buller, 2, *et. al.*) and fructifications of the resupinate *Trametes serialis* types. After the sheathing had been removed a little while, however, the roof became literally a mushroom bed. Sporophores of the former fungus appeared over a period of several weeks, taking about four days for each to become mature. The time of fruiting was the last of June and the first part of July.

The sporophores found in this mill were for the most part quite definitely those of *Lentinus lepideus* in size, shape, and color. They were larger than the size given for *L. tigrinus* by most mycologists and the largest had a greater diameter than the measurements given by Harper (4, p. 371). The majority measured two or four inches, but a few were six or seven inches across. They were not at all umbilicate. Most of them were chalky white and quite smooth, but where there were scales they were of the "lepideus" type—spot-like and not hairy as are those of *L. tigrinus*. An annulus was present in some of the specimens. In parts of the hymenium of some of the sporophores there was a pseudo-veil of hyphae over the gills and the gills were laid flat and appressed one to the other. The hyphae of this veil bore chlamydospores like those already described (8, p. 29), and there was also an abundance of conidia, whether on this mycelium or belonging to a mold could not be determined. The size of the spores in these collections varied somewhat. Spores from some collections measured 7–10.5 x 3 μ, and spores from others were smaller than the measurements given for *L. lepideus*, being within the limits given

for *L. tigrinus* (5–8 x 2.5–4 μ). The writer has found that spores from fungi grown under mill conditions are occasionally smaller than the measurements usually given for a species. This has been found to be true several times with *Lenzites sepiaria* and also, although less often, with *L. trabea* and *Trametes serialis*.

A few mushroom sporophores found with those just mentioned were somewhat different. They were browned and blackened considerably, dried down to a brittle consistency, showing little scaling of the pileus, and instead of being umbilicate were decidedly umbonate. They were larger than the size attained by *Lentinus tigrinus* out of doors, being 5–10 cm. in diameter. They had a pseudo-veil of hyphae which completely covered the gills. The hyphae bore the same type of brown chlamydospores as mentioned above and described previously (*loc. cit.*). This type of sporophore would be more likely to be confused with the abnormal forms of *L. tigrinus*. This browned form is, however, only a stage in the disintegration of the mature sporophore of *L. lepideus*. In one mill, in an opening between planks two inches wide were found all stages of the latter fungus from the fresh white sporulating pilei through the browned, "veiled" type just described, to entirely blackened, shriveled remains rapidly falling to pieces.

Culturally the two fungi are quite distinct. Cultures of the two species have been obtained from the following sources: *L. lepideus* from Lewis, N. Y., and North Conway, N. H., collected by the writer, and from Syracuse, N. Y., collected by Dr. L. H. Pennington; sporophores from the mills mentioned above, collected by F. J. Hoxie and by the writer; *L. tigrinus* collected at Syracuse, N. Y., by Dr. L. H. Pennington; and a culture of *L. tigrinus* loaned by Dr. C. J. Humphrey. Cultures could not be obtained from the blackened, veiled sporophores which have just been mentioned.

There is a point of interest in connection with the culture of *Lentinus tigrinus* obtained from Dr. L. H. Pennington's collection. It was collected in September, 1915, and presumably kept at ordinary room conditions in his herbarium. The specimens were sent to the writer in 1920. In the fall of that year, just five years after collection, the spores germinated at high percentages and single spore cultures were readily obtained. Hence, these spores pro-

tected in the hymenium by the "veil" had remained viable for five years.

The cultures of *Lentinus lepideus* have already been described (*loc. cit.*). *L. tigrinus* shows distinguishable differences in growth on agar, beans, and wood. On agar it forms an abundant white felty growth which later becomes partly verona brown to warm sepia or natal brown, especially on the edges of the cultures, and exudes colorless to brown droplets. *L. tigrinus* has chlamydospores like those of *L. lepideus* (see Lyman, 6, p. 184, pl. 22, figs. 110–114). At 30° C., *L. tigrinus* covers a 100 cm. petri dish in 5 days, whereas *L. lepideus* grows only 15–17 mm. in that time at the same temperature. *L. tigrinus* also forms fruit bodies of the *Lentodium squamulosum* type (Lyman, 6, p. 184, and pl. 23) on both beans and agar (plate 17, fig. 5), while *L. lepideus* in four years of culture has never got beyond the "stump" formation on agar. It has fruited on wood, however. *L. tigrinus* often fruits on beans in 4 days from the time of inoculation. The strong aromatic odor characteristic of all the *L. lepideus* cultures used by the writer on agar or wood has not been noted in the cultures of *L. tigrinus*.

In wood cultures the differences between the two are more striking. *L. lepideus* forms a vigorous soft white cottony growth covering the culture blocks. On coniferous woods *L. tigrinus* grows very poorly and has done very little better on the basswood substrate provided. It does not form the uniform, delicate white weft characteristic of *L. lepideus,* but the slowly advancing growth soon becomes matted and tough and in color is white to the various shades of brown noted in the agar cultures. The growth is bordered by an irregular, crinkled, sulcate zone which is quite different from that seen in any other fungus by the writer.

To gain further evidence as to the identity of the Lentinus occurring in the mills, cultures from a mill collection and from a known specimen of *Lentinus tigrinus* were compared as to their respective abilities to attack the woods from hardwood and coniferous trees.

It was shown (Table II) that *L. tigrinus* is definitely a hardwood fungus. It did not attack any of the coniferous heartwoods,

although it decayed blue-stained western yellow pine sapwood a little. With the hardwoods, the decay induced by this species was much more pronounced, especially in Norway maple and redgum, although *L. lepideus* rotted white oak and basswood more than did *L. tigrinus.*

TABLE II

COMPARATIVE ABILITIES OF *Lentinus lepideus* AND *L. tigrinus* TO ATTACK THE WOODS OF CERTAIN CONIFEROUS AND HARDWOOD TREES, AS INDICATED BY PERCENTAGE LOSS OF OVEN DRY WEIGHT AFTER ONE YEAR OF INCUBATION AT ROOM TEMPERATURE

	Lentinus lepideus, per cent	*Lentinus tigrinus*, per cent
Cypress (*Taxodium distichum*)	34	3
Port Orford cedar (*Chamaecpyaris lawsoniana*)	12	2
Southern yellow pine (*Pinus palustris*)	24	0
Douglas fir (*Pseudotsuga taxifolia*)	20	0
Western yellow pine sapwood (*Pinus ponderosa*)	24	9
Sitka spruce (*Picea sitchensis*)	25	0
Eastern white pine (*Pinus strobus*)	25	0
White oak (*Quercus alba*)	24	1
Norway maple (*Acer pseudoplatanus*)	35	45
Redgum (*Liquidambar styraciflua*)	24	40
Basswood (*Tilia americana*)	15	10
Yellow poplar (*Liriodendron tulipifera*)	3	20

The apparent impossibility of *L. tigrinus* growing upon a roof made of coniferous timbers and all the evidence preceding leave little opportunity for calling any of the mill forms of Lentinus thus far collected anything but *L. lepideus.*

The taxonomy and morphology of the form of *Lentinus tigrinus* with the abnormal gills have been discussed by various writers, especially since Morgan (7) maintained that it was autonomous and named it *Lentodium squamulosum.* Lyman (6, p. 188) agreed with Morgan, for in his culture studies he produced the same type of fruit bodies from spore cultures. In reference to this latter work, Harper (4, p. 377) has suggested that the so-called "veil" of this form is a layer of parasitic hyphae, and that Lyman's cultures may have been contaminated by the conidia of the parasite. He remarks that to make the evidence complete, cultures should have been made from the normal form and from mixtures of both forms. The writer was unable to do this to complete the case, but

has one other point of evidence which corroborates Lyman's work. The cultures of *Lentinus tigrinus* used (*Lentodium squamulosum* form, it will be remembered) were obtained from single basidiospores, as mentioned above, and the results were similar to Lyman's—*i.e.*, the abnormal form of fruit body was obtained in every culture. It would be desirable to make the other cultures as Harper suggests, but the writer's single basidiospore cultures satisfy Harper's most serious criticism, because there can be no question of contamination in these cultures.

SUMMARY

Observations are recorded upon the occurrence of the following fungi in cotton mills: *Fuligo ovata* (Schaeff.) Macbr., *Stemonitis fusca* (Roth) Rost., *Reticularia lycoperdon* Bull., *Peniophora pubera* (Fr.) Burt, *P. gigantea* (Fr.) Mass, *Coniophora cerebella* Pers., and *Merulius lacrymans* (Wulf.) ex Fr.

Lenzites sepiaria Fr. and *L. trabea* Pers. ex Fr. are compared as to their importance in the decay of coniferous roof planks, time and manner of fruiting within mills, identification, cultural characters, etc.

Authentic cases of decay of weave shed roofs by *Trametes serialis* Fr. are reported. The danger is emphasized of imputing certain cases of decay to *Fomes officinalis* Vill. because of a similarity of characters shared by this species and abortive forms of *Trametes serialis*.

Brief observations are reported upon the occurrence and cultural characters of *Trametes carnea* Nees ex Cooke (called *Fomes roseus* Alb. and Sch. ex Cooke in a previous paper).

Evidence is adduced to show that the Lentinus found decaying weave shed roofs is *L. lepideus* Fr. and not *L. tigrinus* Fr. This evidence is derived from a comparative study of the sporophores, spores, wood and agar cultures of the two species, and durability tests upon woods of coniferous and hardwood trees. *L. tigrinus* was unable to decay any of the coniferous heartwoods tried.

Basidiospores of *Lentinus tigrinus* from beneath the veil of a specimen kept in a herbarium for five years germinated at high percentages. The writer's single basidiospore culture of this species adds another bit of evidence to the discussion of the questioned

autonomous nature of the *Lentodium squamulosum* form of *Lentinus tigrinus*.

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EXPLANATION OF PLATE 16

Fig. 1. Surface view of mature, resupinate, fruiting body of *Trametes serialis* collected from a spruce weave shed roof. Nat. size.

Figs. 2 and 3. Sectional view of mature fruiting bodies of *Trametes serialis* growing from cracks between spruce planks of weave shed roof. Nat. size.

Fig. 4. Mature sporulating sporophore of *Lentinus lepideus* from a spruce weave shed roof. Nat. size.

Fig. 5. Fruit bodies of *Lentinus tigrinus* (*Lentodium squamulosum* form) formed upon bean cultures in four days after inoculation. Nat. size.

GENERIC CONCEPTS IN THE PYTHIACEAE AND BLASTOCLADIACEAE

H. M. Fitzpatrick

I. Concerning Septocladia Coker & Grant

In a recent paper bearing the title "A New Genus of Water Mold Related to *Blastocladia*" the above genus is described as new by Coker & Grant.[1] The authors base the genus on a single species, *S. dichotoma* n. sp., which differs from the members of *Blastocladia* strikingly in that its thallus is normally and regularly septate. The species is compared with the four species of *Blastocladia* described by v. Minden in his treatment of the Blastocladiaceae in Kryptogamenflora der Mark Brandenburg,[2] and a detailed description and figures are given. Unfortunately, several papers of importance in this connection have been overlooked.

Butler [3] and Barrett,[4] working independently, published almost simultaneously descriptions of two species which are clearly congeneric with that described by Coker & Grant. Butler called attention to the septate character of the thallus and founded the genus *Allomyces* to include his species which he named *A. arbuscula* n. sp. Barrett, approaching the study of his species from the cytological point of view, studied material both *in toto* and in paraffin section, and was able to demonstrate that the septa are merely perforated pseudo septa comparable to those of the Leptomitaceae. He was content to widen the limits of the genus *Blastocladia* to include his species which he named *B. strangulata* n. sp. Four years later v. Minden [5] incorporated the species in the genus

[1] Jour. Elisha Mitchell Sci. Soc. 37: 180–182. *pl. 32.* 1922.

[2] 5: 601–606. 1912.

[3] On *Allomyces*, a New Aquatic Fungus. Ann. Bot. 25: 1023. 1911.

[4] The Development of *Blastocladia strangulata* n. sp. Bot. Gaz. 54: 353–371. *pl. 18–20.* 1912.

[5] Beiträge zur Biologie und Systematik einheimischer submerser Phycomyceten. *In* R. Falck, Mykologische Untersuchungen und Berichte 214. 1916.

Allomyces Butler as *A. strangulata* (Barrett) v. Minden. The genus including this species and that of Butler, and *Blastocladia* embracing the four species above mentioned, constitute the new order Blastocladineae in v. Minden's revised classification. The two genera are very closely related.

A critical examination of the description and figures published by Coker & Grant reveals no evident point of difference between their species and that of Barrett, and the writer considers them to be the same. The material in both cases was collected in the eastern United States.

II. RHEOSPORANGIUM APHANIDERMATUM Edson

Several years ago Edson [6] cited *Aphanomyces levis* DeBary as the cause of a new seedling disease of sugar beets. Later he [7] discovered that his fungus was in fact not that species, and, failing to find in the Saprolegniales a genus which would include it, he [8] founded for its reception the new genus *Rheosporangium.* As a basis for his taxonomic study he used the classification of v. Minden [9] in which the Pythiaceae are excluded from the Saprolegniales. Edson's description of *Rheosporangium* and the drawings illustrating it recalled at once to the writer's mind the genus *Nematosporangium* Schroet.[10] of the Pythiaceae. This genus is equivalent to the subgenus *Aphragmium* of *Pythium* as treated by Butler,[11] and includes those species in which the sporangium is filamentous in character. The members of the group are for the most part parasitic in algae. Butler describes *P. gracile* Schenk. as occurring in green algae and also as causing a serious disease of ginger (*Zingiber officinale*) in India. The fungus on ginger has been segregated under the new specific name, *P. Butleri,* by Subra-

[6] Damping-off and Root-rot Parasites of Sugar Beets. Phytopathology 3: 76. 1913.

[7] Seedling Diseases of Sugar Beets and their Relation to Root-rot and crown-rot. Jour. Agr. Res. 4: 165. 1915.

[8] *Rheosporangium aphanidermatus*, a New Genus and Species of Fungus Parasitic on Sugar Beets and Radishes. Jour. Agr. Res. 4: 291. 1915.

[9] Saprolegniineae. Kryptogamenflora der Mark Brandenburg 5: 504. 1912.

[10] Engler & Prantl. Die Natürlichen Pflanzenfamilien 1^1: 104. 1893.

[11] An Account of the Genus *Pythium* and Some Chytridiaceae. Mem. Dep. Agr. India Bot. ser. 1: 61. 1907.

maniam,[12] who states that it also attacks tobacco and papaya. Finally, Carpenter [13] has found the same organism in Hawaii causing the Lahaina disease of sugar cane. Carpenter has compared his fungus with that of Subramaniam and with *Rheosporangium aphanidermatum* Edson and finds them all to be one species. He applies the name *Pythium Butleri* Subramaniam. As the specific name of Edson antedates that of Subramaniam the binomial **Pythium aphanidermatum** (Edson) comb. nov. is to be preferred. If the genus *Nematosporangium* is recognized, which seems to the writer desirable, then the species should bear the name **Nematosporangium aphanidermatum** (Edson) comb. nov.

In *Nematosporangium* the swarmspores are freed from a thin-walled vesicle or bladder which forms at the mouth of the sporangium. Edson designates this vesicle as the sporangium, and introduces the new term "presporangium" to apply to the sporangium proper. This terminology has little to recommend it, and if used in the closely related group, *Phytophthora,* would lead to confusion, since there, in a single species, the sporangium may free its swarmspores with or without the formation of a vesicle. The older term "prosporangium" used by other authors in similar situations should be preferred to "presporangium" in any case.

III. The Pythium-Phytophthora Problem

A critical reading of the papers which have appeared in recent years dealing with the various species of *Pythium* and *Phytophthora* must have raised in the minds of many students the question of the identity of these genera. The effort will here be made to review the salient features of the situation, and to present the evidence indicating that the two genera should be united.

Pringsheim in founding the genus *Pythium* placed it in the Saprolegniaceae. DeBary recognized its affinities with his own genus *Phytophthora,* and classed both with the Peronosporaceae. The majority of the students of the Phycomycetes, including

[12] A Pythium Disease of Ginger, Tobacco, and Papaya. Mem. Dep. Agr. India 10: 181–194. 1919.

[13] Morphological Studies of the Pythium-like Fungi Associated with Root-rot in Hawaii. Bull. Exp. Sta. Hawaiian Sugar Planters' Assoc. Bot. ser. 3: 62. 1921.

Fischer, Butler, and v. Minden, have agreed with DeBary, while a few have returned to the older point of view of Pringsheim. Schroeter [14] has elevated the subgenus *Nematosporangium* of *Pythium* to generic rank, and makes this genus and *Pythium* the basis of a separate family of the Saprolegniales, the Pythiaceae, coördinate with the Saprolegniaceae and Leptomitaceae. He includes *Phytophthora* in the Peronosporaceae, calling attention to the fact that it differs from the other genera of the family in developing its sporangia successively rather than simultaneously. He fails to give an adequate separation of the Pythiaceae and Peronosporaceae. Fischer [15] treats *Pythium* and *Phytophthora* as closely related genera of the Peronosporaceae, and points out that they differ from the higher genera of the family not only in the successive development of their sporangia, but also in lacking a well-defined conidiophore. His basis for the separation of *Pythium* and *Phytophthora* is in the light of our present knowledge insufficient. In general it can be said that these genera differ far more strikingly from the other genera of the Peronosporaceae than they do from each other.

We are indebted chiefly to Butler [16] for our knowledge of the genus *Pythium*. His monographic account of the genus is, in fact, the only general paper of importance in this field. His statements with reference to the basis for the separation of *Pythium* and *Phytophthora* may be said to be, therefore, the most authoritative which we have. He admits that the genera are very closely related, but says:

"The genus *Pythium* is separated from all the rest (of the Peronosporaceae) by liberating its zoöspores in an imperfectly differentiated state into a bladder at the mouth of the sporange, in which differentiation is completed. There are other minor differences, such as aërial habitat and parasitism of the Peronosporaceae, the formation of haustoria correlative with the latter, etc. None of these differences are absolute."

In other parts of the same paper he emphasizes the point that the delimitation of the zoöspores begins in the sporangium and is

14 Engler & Prantl. Die Natürlichen Pflanzenfamilien 1[1]: 104. 1893.

15 Rabenhorst, Kryptogamenflora von Deutschland etc. 4: 391. 1892.

16 Mem. Dep. Agr. India Bot. ser. 1: 1–158. *pl. 1–10.* 1907.

completed in the thin-walled vesicle at its mouth. For example, in describing the discharge of the sporangium as observed in *Pythium rostratum* he writes:

"The flow resembled that of porridge forced through a hole, but with one difference. The granule directly opposite the opening was not always the first to escape. It was sometimes shoved aside by one to the right or left. From this I have been led to suppose that even at this stage the spore-origins are definitely formed and that, though fused into a mass in which individual spores can not be made out, yet each nucleus has obtained a hold on a certain mass of cytoplasm which passes out with that nucleus. Hence in passing out, when the nucleus engages in the tube it draws its cytoplasm with it, whether this be directly in the center or to one side of the opening."

At another place he says: "In the vesicle the *final fashioning* of the zoöspores occurs."

The formation of a thin-walled vesicle at the mouth of the sporangium is not restricted to *Pythium*. A similar structure has been described in *Polyphagus, Myzocytium, Lagenidium, Rhipidium,* and other genera of the lower Phycomycetes, while Dastur [17] and Rosenbaum [18] state that it is sometimes formed in at least a part of the species of *Phytophthora*. It has been seen in *Phytophthora cactorum, P. arecae,* and *P. parasitica* by Rosenbaum and in *P. parasitica* by Dastur. The former writer says: "Perhaps its evanescent nature explains why it had not been previously observed in some or in all the forms." As is well known, the more usual type of swarmspore discharge in *Phytophthora* is that in which the spores escape directly from the mouth of the sporangium without the formation of the bladder.

Butler in the paper referred to above describes somewhat imperfectly under the name *Pythium palmivorum* a species which in its various characters may be said to be strikingly similar to *Phytophthora*. In a later contribution [19] he discusses this species at con-

[17] On *Phytophthora parasitica* nov. spec., a New Disease of the Castor Oil Plant. Mem. Dep. Agr. India Bot. ser. 5: 177–231. 1913.

[18] Studies of the Genus *Phytophthora*. Jour. Agr. Res. 8: 252. 1917.

[19] The Bud-rot of Palms in India. Mem. Dep. Agr. India Bot. ser. 3: 221–280. *pl. 1–5.* 1910.

siderable length, and in the description of sporangial germination says:

"Four types of germination occur, which, though distinct enough in appearance, are all modifications of the one process. The most characteristic, though by no means the most common, is that which is practically universal in the genus *Pythium* and which is *the only absolute mark of distinction* of this genus from *Phytophthora*. In this case the apex of the papilla swells up into a thin gelatinous vesicle into which the protoplasm of the sporangium passes in a uniform granular mass. Within the vesicle it segments to form a number of zoöspores, which develop cilia and move ever more vigorously in the confined space, until the vesicle wall ruptures and the spores swim off in all directions. In some cultures prolonged search was necessary to find instances of this type of germination; in others it was quite common. On the whole it is less frequent in the cooler months of the year than that next to be described.

"This is simply an incomplete form of the last, in which the vesicle is either not formed at all, the apex of the papilla dissolving, or if formed, ruptures almost immediately. Segmentation into zoöspores occurs within the sporangium, and is complete or nearly complete before the papilla opens. As soon as an opening forms, the protoplasm streams out and breaks up at once into free swimming zoöspores. Owing to the pressure of the mass within the sporangium it is not possible to distinguish the individual zoöspores before escape, but it is evident that they must be fully formed before the rupture of the papilla, since they separate at once after escape, and also because as soon as pressure is reduced by the extrusion of part of the sporangial protoplasm, the remainder may segment while still inside and emerge as fully formed mature zoöspores. This is the type of zoöspore formation habitually met in *Phytophthora*, and in several cases the palm parasite would have been taken for a *Phytophthora* had not prolonged search revealed an occasional instance of the first type of discharge. Intermediate types between the two are sometimes found. Thus in one case about three quarters of the protoplasm emerged in a mass surrounded by a vesicle, which then dissolved, and the

mass at once broke up into individual zoöspores, as did the remaining one quarter still within the sporangium at the moment of rupture of the vesicle. Sometimes the vesicle is formed in the ordinary way, but the zoöspores are almost mature when they leave the sporangium and the vesicle early dissolves to liberate them."

The third type of germination described is that in which zoöspores failing to escape from the sporangium round off and germinate *in situ*. The fourth is that in which the unopened sporangium germinates by one to several germ tubes.

The species seems to be an obligate parasite. Its mycelium is intercellular and bears haustoria. Definite conidiophores do not occur, the sporangia being borne on the ordinary hyphae.

In a recent paper Sharples and Lambourne [20] state that "Butler has reconsidered this fungus as *Phytophthora palmivora*." They make no further comment on the change, and he apparently has not published under the new name.

Though the transfer of the species to *Phytophthora* removes from *Pythium* the only species of the genus in which the zoöspores have been described as escaping directly from the sporangium, it places in *Phytophthora* a species in which zoöspore formation may take place in the manner described as typical of *Pythium*. The species furnishes, in other words, a form intermediate in its characters between the two recognized generic concepts, and leaves us without even a single "absolute mark of distinction" between them.

The attempt to determine the exact points in sporangial discharge at which zoöspore formation begins and ends, for use as a basis for segregation of the species of this general group into the two genera, *Pythium* and *Phytophthora*, seems at best an unsatisfactory procedure. Unless a more tangible taxonomic character can be found to serve for this separation it would be less confusing to merge the two genera into one. In fact, in the light of our present knowledge there seems to be no other course to pursue. In this connection it should be mentioned that Lafferty & Pethybridge [21] in a recent paper show that there is no longer a basis for

[20] Observations in Malaya on Bud-rot of Coconuts. Ann. Bot. **36**: 55–70. 1922.

[21] Sci. Proc. Roy. Dublin Soc. **17**: *29–43*. *pl. 1–2*. 1922.

the recognition of the genus *Nozemia,* several species having been found to possess both amphigynous and paragynous antheridia. In merging the genera *Pythium* and *Phytophthora,* the name *Pythium* would of necessity be retained for the group, since it is the older.[22]

The writer suggests that the family Pythiaceae, consisting of the forms now included in *Pythium* and *Phytophthora,* and their nearest relatives, *Pythiogeton* and *Pythiacystis,*[23] be incorporated in the Peronosporales as a family distinct from the Peronosporaceae. These forms differ from the Peronosporaceae (*Plasmopara, Sclerospora, Peronospora,* etc.) in their successive development of sporangia, the absence of well-defined conidiophores, their saprophytic tendencies, less typically deciduous sporangia, etc.

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[22] It is not the writer's intention that this discussion be regarded as constituting the actual merging of the two genera.

[23] *Pythiacystis* should apparently be merged with *Phytophthora.* See Phytopathology 7: 150. 1917 and 10: 397. 1920.

PHOMA: A SAMPLE OF MYCOLOGICAL NOMENCLATURE AND CLASSIFICATION[1]

C. L. Shear

When asked by our non-botanical friends why we use jaw-breaking Latin names for plants instead of the common ones with which they are familiar and which seem to them much simpler and more appropriate, we are wont to explain in a very learned and impressive manner that the common names are local and lack precision, the same vernacular name being applied to different plants in different places, and that they would not be understood by foreigners or botanists in other localities. Latin, however, is the universal language of systematic biology, understood and used by botanists of all nations, and when a Latin binomial name is written every botanist in the world knows exactly what plant is referred to; but if you should refer to the plant by its common English name, you might not be understood by all English-speaking people, and probably not at all by foreigners. The natural inference of the innocent bystander might be that the name we use is the only Latin name applied to the particular plant, and that this name is not applied to any other plant. Most systematic botanists at least know, and all others should know, that the above statement regarding Latin names is not in accordance with the facts, as most plants have several or many Latin binomial names, and at present there is no uniform usage throughout the botanical world either in the use or application of either generic or specific names. The condition in nomenclature and taxonomy is bad enough as it obtains among flowering plants which are conspicuous objects, long known and studied. When, however, one makes more than the most superficial study of the condition existing among the fungi, he finds that, in general, chaos rather than order and system prevails in the application and limitation of generic and specific

[1] Read before the Mycological Section of the Botanical Society of America at the Boston Meeting, Dec. 28, 1922.

names. Among the higher and more conspicuous fungi this condition is naturally less striking than among the smaller organisms, which require careful microscopic study to determine their distinctive morphological characters and relationships.

As an example of the present rather general condition, let us trace briefly the nomenclatorial history of *Phoma,* a name so common as to be familiar to the beginner in mycology. Examining the 22 volumes of Saccardo's Sylloge fungorum, which only brings us down to 1913, we find *1722* so-called species of *Phoma* given. A considerable genus! An " omnium-gatherum " would be a much more appropriate designation than " genus " for this heterogeneous mass of material.

The genus *Phoma* was first described by Fries (**1819**) as follows: " PHOMA. Differt thecarum indole & perithecii defectu a Sphaeria. Typus: *Sph. pustula* P." Being translated, I take this to mean that the genus *Phoma* differs from *Sphaeria* in the nature of the asci and in lacking perithecia, and that the type is *Sphaeria pustula* Pers. It would seem evident to any mycologist at present that this description alone was scarcely sufficient for the satisfactory identification of a fungus-genus. The same remark would apply, however, to some of the generic descriptions published at present. Before judging our distinguished predecessor too harshly we should consider the condition of mycology at that time and the prevailing lack of knowledge of the morphology of the smaller fungi, especially the pyrenomycetes, which then included not only the ascogenous forms with true perithecia, but also practically all the imperfect, pycnial forms which were largely referred to the old genus *Sphaeria.*

In order to understand the situation, we must remember that a totally different concept of the origin and development of the organic world obtained a century or two ago from that which is in vogue among biologists today. Species at that time were believed to have been created directly by omnipotent edict and fashioned by the Creator according to particular ideals or models and were constant in character. You may recall that one of the explanations of the occurrence of fossil animals and plants given by some churchmen and philosophers was that they were the discarded

models from the Creator's work shop. Botanists and zoölogists were also influenced by these beliefs and this probably was Fries's idea in specifying the type, as he (**1835**) said later, in speaking of a natural system, that it is really supernatural and that each division of such a system is the expression of an idea in a living form.[2] Since he distinctly specifies that *Sphaeria pustula* Pers. is the type of the genus, it would seem rather natural that this plant, which had been fairly well described by Persoon and was correctly identified and distributed later by Fries, should have been taken as the basis for the interpretation and application of his generic name. Fries himself apparently did attempt to refer to the genus only such species as his very limited knowledge of their microscopical characters led him to believe were congeneric with his type.

In 1823 Fries again in his Systema mycologicum treated *Phoma,* modifying and enlarging the description somewhat and stating that neither perithecia nor asci were present, but including his original type, *P. pustula,* and also *Sphaeria saligna* Ehrh., both of which, notwithstanding his description, have good perithecia and asci. He also included several other species of pycnial forms. During the interval between 1819 and 1823 he had apparently retrogressed in his knowledge of the true character of the plant which he originally called *Phoma.*

In 1825, in Systema orbis vegetabilis, he again discussed the genus, attributing to it essentially the same characters as before and placing it in his order Cytosporei, which he describes as having "asci wanting or disappearing; or rather sporidia, sacks or cells, which may be depauperate asci, that is, thecae of authors." Fries, as well as most other mycologists of that period, did not have a clear idea of true asci. Besides the true ascus the term was frequently applied to a multiseptate spore or to a spore containing vacuoles or oil globules. In 1828, in Elenchus fungorum, Fries added another species, *P. hederae* Desm., to the genus. Subsequent authors such as Wallroth (**1833**), Berkeley (**1836**), Corda (**1842**), and Rabenhorst (**1844**) simply repeat in substance Fries's

[2] This is a free translation of a quotation from Fries, l.c. given in Sachs' History of Botany, Eng. Trans., p. 111, 1906. I have been unable to find the latter half of Sachs' quotation in the book cited, but as no page is given it may have been overlooked.

description and refer to the genus, the species he originally used, *P. pustula* and *P. saligna.* Léveillé (1845) referred to the genus a species which was probably what is now called *Sphaeropsis.*

In 1849 Fries, in Summa vegetabilium Scandinaviae, published his last account of the genus *Phoma* and says in italics at the end of the diagnosis, " *typically ascigerous,*" and includes four species, his original monotype, *P. pustula,* also *P. saligna, P. populi,* and *P. hederae.* The last, however, a nonascogenous form, he says he does not consider a good *Phoma.* It is clear from this that in the interval between 1825 and 1849 he had discovered that his original type as well as *P. saligna,* which he had already referred to the genus, contained good asci. Therefore, he corrected his previous descriptions and emphasized this character.

Up to 1849 comparatively few species had been referred to the genus by Fries or other authors and these were in part true pyrenomycetes with good perithecia and asci. There would seem to have been no justification, therefore, for applying the name to pycnial forms only. The same year, however, Desmazières, who was describing numerous " new species " of fungi, decided that the *Phoma* of Fries needed emending. Possibly he had not seen Fries's latest statement regarding it. He published a new description of the genus in which he states that it should be characterized as having membranaceous or corneous perithecia without asci, that is, true pycnia, according to present terminology, but with filiform basidia bearing terminal, minute, hyaline sporidia with two sporules. These were in reality only vesicles or oil globules. He further remarks that the form of the sporidia and the presence of two globose sporules is important and discusses the supposed nature of these so-called sporules, which he says some authors have interpreted as merely shadows. He also adds that Montagne is correct in considering these fruiting bodies as false perithecia.

It will be observed that the characters which Desmazières ascribed to *Phoma* are very different from those which had previously been attributed to it by Fries and other mycologists. He says that mycologists should not be the slaves of ancient ideas, and that he desires, without disturbing the " natural relations " of the genus, to avoid the difficulties arising from the application of too

restricted characters, which continually shackle mycologists. He then proceeds to describe and refer to his "emended" genus 10 species, all of which are pycnial forms, only two of which had been previously described, and none of which had ever before been referred to the genus *Phoma*. It certainly requires a great stretch of the imagination to see any relation between Fries's genus *Phoma* and that of Desmazières. In reality Desmazières simply applied the name *Phoma* to an entirely different group of fungi from that for which it was intended by Fries, and it is therefore no more or less than a homonym. If Desmazières could behold the result of his efforts to prevent the "shackling" of mycologists in the use and application of *Phoma*, it might perhaps exceed his fondest expectations.

Referring to Saccardo's compilation of the so-called species of *Phoma*, we find, as already stated, over 1,700, and they are still being multiplied rapidly. To refer a fungus to *Phoma* at present is little more than a confession of ignorance of the organism in hand or its relationship. It is about as scientific and satisfactory a method of classifying fungi as dumping miscellaneous letters into a waste-basket would be of filing correspondence.

Following Desmazières's example subsequent mycologists continued to refer the great bulk of pycnial, and in some cases non-pycnial, forms having hyaline, nonseptate spores to this so-called genus. This proceeded until 1882, when Saccardo (1882) tried his hand at further "emendation" of the genus and described it as follows: Perithecia smooth, without a beak, subcutaneous not maculicolous [this is supposed to separate it from *Phyllosticta*], spores without appendages. This, however, did not improve matters much so far as restricting its application was concerned.

The great number of so-called species of *Phoma* and the great diversity of their morphological characters and relationship finally so forcibly impressed some of the mycologists, who had made a little closer study of the microscopic characters of some of the plants, that they began to lop off from the great heterogeneous mass groups of species here and there, which were clearly distinguished by some more or less conspicuous character. Thus were segregated *Macrophoma, Dendrophoma, Rhyncophoma,* and many

other genera. No one, however, attempted to attack the problem in a systematic or scientific manner and the final result of this method, or lack of method rather, if pursued to its logical conclusion, will be that finally the name *Phoma* will be left stranded with a lot of odds and ends of species listed in an appendix as "imperfecte cognitae," as is already the case with the old generic name *Sphaeria*. This sad fate, however, may perhaps be averted if mycologists can be led to apply some rational method to the treatment of nomenclature and taxonomy.

The idea of anchoring generic and specific names by attaching them permanently to a particular species or individual to which they were first applied—that is, a nomenclatorial type—is gradually becoming recognized as a practical and consistent method of avoiding some of the serious difficulties into which past practices, such as we have just described, have led us. The earlier mycologists were so busy naming new species and genera that they did not usually take time to determine their characters in detail or with the accuracy which might have been attained with the imperfect microscopes available, and even today descriptions are so far from perfect that they can not safely be relied upon as the primary basis for fixing or applying names.

It is most remarkable how prone we still are to confuse ideas or concepts with things. It seems necessary to get more firmly established in our minds the fact that genera and species of living organisms consist of material entities and not metaphysical concepts, and that they are made up of individuals and groups of individuals, and also that our nomenclature and taxonomy must be based on these material things and not on incomplete or inaccurate descriptions of them. No description, however detailed, can completely depict a species or genus. The only way we can get any adequate idea of either is by thorough study and comparison of actual specimens or individuals (the more of them the better) of the organism described.

In this connection it is very important to make clear what is evidently not so in the minds of some, and that is the difference between so-called biological and nomenclatorial types. The biological type in its present conception seems to be a sort of emended

or modernized application of the old idea, which we have mentioned regarding the supposed models followed in creation. The biological type of a genus would be the particular species of a genus, which embodies in itself all of the essential and fundamental characters of the genus—that is, an ideal species of which all other members of the group are clearly modified forms—whereas the nomenclatorial type is simply the species to which the original author first applied the name (or one of the species, where several were used) and which serves to fix the generic name in its particular application and usage. Consequently the nomenclatorial type of a genus may not be identical with its biological type (supposing that such a thing exists), but may happen to be a species which is more or less atypical, but still can be recognized as belonging to a distinct group of species to which the generic name is applied. The definite limitations of a genus can not and should not be fixed, as they must change more or less with advancing knowledge and with the various interpretations of monographers.

The idea of applying the method of generic and specific types, as a means of securing greater stability and uniformity in the application of names, has been gradually receiving more and more attention from systematic botanists, and when its advantages are thoroughly understood will probably be adopted, as it has already been by systematic zoölogists.

It has already appealed to a few mycologists so strongly that they have attempted to put it in practice according to their own individual ideas of its application. As there is obviously more than one possibility in the selection of a type in all except monotypic genera, it is very important that there should be a general agreement among mycologists as to the exact method to be pursued in determining the type in such cases, otherwise various and quite different results may be obtained by different workers and thus bring discredit to the method and fail to accomplish its purpose. This is aptly illustrated by the work of the late excellent mycologist, von Höhnel, in connection with this particular genus, *Phoma*.

Von Höhnel (**1918**) in discussing this genus begins by stating correctly that Fries originally established it in 1819 (a fact, by the

way, not usually stated by recent mycologists, who are too frequently satisfied by referring to any place where the author used the name or his most readily available or best known work). He also correctly states that Fries specified the type as *Sphaeria pustula* Pers. = *Hypospila pustula* of recent authors. He says the standard of judging the genus, however, should be Fries's account in his Systema in 1823, where *Phoma saligna* (Ehrh.) = *Linospora saligna* of recent authors happens to be mentioned first in the list of species, though *P. pustula* is also included. This would result in the application of the name *Phoma* to a different genus of pyrenomycetes from that to which it would be applied if Fries's original monotype were taken—*i.e.*, the present *Hypospila pustula.*

Von Höhnel does not so state, but the natural inference is that he took the type from Fries's Systema (**1823**), because this was one of the various dates selected at Brussels as the starting point for the nomenclature of certain groups of fungi. Even accepting this date, there seems to be no good reason why he should not have taken Fries's original type. Be this as it may, whichever species of Fries is taken as the type, there seems to be no way in which Fries's name, *Phoma,* can be properly applied to any of the species referred to it today.

The nomenclatorial type of the genus *Phoma* of Fries should undoubtedly be *Sphaeria pustula* Pers., which he distinctly specified as its type when he first established the genus. The type of *Phoma* of Desmazières is an entirely different thing and the name as used by him is a homonym and untenable on account of its earlier use by Fries.

It may seem to some that we are unduly disturbed over this question of nomenclature, and that its importance in mycology is much overestimated. I admit that life histories, physiology, comparative morphology, cytology, and various other phases of the subject are more interesting and of greater scientific importance. It can not be denied, however, that whatever branch of mycology one pursues, he is obliged to use names for the organisms he deals with, and, unless these names are applied with accuracy and uniformity by the different workers, great confusion and misunderstanding results and the progress of science is impeded.

We have now reached the stage in the development of systematic mycology where it is going to be necessary to revise greatly and rearrange the genera and species of fungi on the basis of a greater knowledge of their life histories, comparative morphology, and development. Whatever permanent success is attained must to a considerable extent depend upon the adoption of a satisfactory and generally approved and adopted method of fixing the application of the great mass of generic and specific names on a type basis.

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THE GENUS CHRYSOMYXA

James R. Weir

(With Plate 17)

The genus *Chrysomyxa* was established by Unger in 1840 on *C. abietis* (Wallr.) Unger, an autoecious leptoform on *Picea* having only telia in its life cycle (*Leptochrysomyxa* of Winter). In this sense Arthur (1) restricted the genus and established *Melampsoropsis* (Schroet.) to include those species having all spore forms. Although the genus is usually interpreted as including both short and long cycle forms, it is here used in its restricted sense. It is interesting to note that the species having all spore forms have their pycnia and aecia also as far as known on *Picea*.

Chrysomyxa Unger

Original description of the genus:

Stroma mucose-granulosum inferius in floccos simplices vel ramosos, superius in utriculos asporos secedens parenchymate plantarum vegeto innatum.

The genus may be characterized as follows:

Telia single, rarely united, arranged in short or elongated sori in one or more rows, protruding in definite cylindric or tongue-shaped, lemon-yellow to orange-red waxy masses, pulvinate; teliospores produced in simple or branched columns of from 3–8 spores more or less united laterally, soon separating, oblong to cubic with smooth hyaline membrane, germinating as soon as mature with a typical promycelium. Basidiospores round to ovoid.

Chrysomyxa abietis (Wallr.) Unger, Beitr. Vergl. Path. 24. 1840

Blennoria abietis Wallr. Allgem. Forst. u. Jagdzeitg. 65. 1834.
Caeoma piceum Hartig in Sched.
Uredo epidermoidalis Hartig, Verhandl. Harz. Forstv. 61. 1864.
Sphaeria navicularis Wallr. Tharandter Jahrbuch. 111. 1853.

Unger's original description is as follows:

Maculis elongatis, uni- v. biserialibus, flavo-rubicundis, dein epidermide rupta cinctis. In foliis *Pini abietis* L.

Redescription:

Telia foliicolous usually appearing on conspicuous yellow spots, or without change of color in the leaf, waxy, linear-oblong, single or united, 0.5–12 mm. long, 0.3–0.5 mm. broad, 0.5 mm. high, orange-yellow to reddish-brown, ruptured epidermis not conspicuous; teliospores catenulate in columns 50–100 μ long, cylindric-elongate, slightly enlarged above, orange-yellow 20.2–30 x 10–16 μ; wall colorless, 1 μ thick, smooth.

On Pinaceae.

Picea excelsa Link on imported nursery stock from Denmark, at Louisville, Kentucky, May, 1907, Weir. Hartz Mts., Saxony, and Hohenschwangau, Bavaria, 1909, Weir. Other collections in the writer's herbarium are from Austria, Switzerland, France, and Russia.

Farlow (2) refers a collection on *Abies canadensis* made in June, 1883, in Essex County, Massachusetts, to *C. abietis,* but with reservations owing to the immaturity of the material.

Chrysomyxa weirii Jackson, Phytopathology **7**: 353. 1917.

Original description:

O. Pycnia unknown, probably not formed.

III. Telia foliicolous on yellowish spots, prominent, waxy in consistency, elongate-elliptic, 0.5–1.5 mm. long, occasionally confluent, dull-orange to orange-brown, ruptured epidermis conspicuous; teliospores catenulate soon separating, oblong or fusiform, 5–7 x 16–28 μ, truncate or attenuate at either end, abutted or overlapping, sometimes only slightly so at one side; wall colorless, thin, 1 μ or less, smooth.

On Pinaceae.

Picea engelmanni Parry. Gold River, British Columbia, June 10, 1911, E. W. D. Holway; Priest River, Idaho, May, 1915, J. R. Weir, *68;* Whitman National Forest, Oregon, July 17, 1913, J. R. Weir, *271,* type.

The species has been collected abundantly at a few stations by the writer in Washington, Idaho, and Montana. It is chiefly distinguished from *C. abietis* by its larger and more conspicuous telial

column with less tendency to branch, less elongated sori, and by its narrower and smaller spores.

Since 1914 this interesting short cycle rust on *Picea* has been collected annually by the writer. In July and August, 1917, it was collected in abundance at Evaro, Montana, and near Victor, Montana, where a study was made on its life history. The rust occurs from practically sea level to the alpine zone, but is more abundant in the mountains of Idaho and Montana. Trees of all age classes are attacked, but it is usually most common on young trees whose crowns are overtopped. The rust is chiefly confined to the lower branches of mature trees. This is in common with most foliicolous forest-tree rusts. The factors for germination and infection are apparently less favorable the higher the crown. On isolated and individual trees ranging in age from 5–10 years the rust is often so prevalent as to kill all the needles on the young shoots, sometimes causing complete defoliation the following spring. The shoots thus defoliated rarely die, but produce a new crop of needles the following year. Infection occurs in early spring. The overwintered teliospores were found germinating on the still attached needles in April and May. The sporidia are carried by the wind to the tender needles of the new shoots, where they germinate and very rapidly cause infection. By the middle of May the infected needles become apparent by their yellowish banded appearance. The color is due to numerous particles of a yellow deposit in the mycelium which may be extracted in water to form a beautiful amber-colored liquid. The seat of infection may be on any part of the needle. The yellowish infected areas alternating with the deep-green of the uninfected parts gives the needles a very conspicuous appearance. The telial pustules, ranging in number from 1 to 5, are usually produced at the angles of the needles. By the last of June or July development is well advanced, but not complete. The infected needles remain on the tree and in the spring the telial stroma completes its development, ruptures the epidermis longitudinally, and appears as a waxy yellowish-orange column flattened laterally. The teliospores now germinate *in situ* and produce a 4-celled promycelium with sterigmata from which a single sporidium is produced. The new

needles of the season are infected and the cycle is repeated. After sporulation the telial pustules dry up and the needles fall from the tree.

Infections do not occur uniformly throughout a stand of spruce. Individuals here and there are infected year after year, while their nearest neighbors remain free from rust. Hartig (3) notes a similar condition in the case of *C. abietis* and attributes it to the backward growth of certain individuals at the time the sporidia are mature. There is no doubt, however, but that the rust occasionally adapts itself to a particular individual. Until 1918, when the tree was destroyed by fire, a young spruce about 15 years old, near the writer's field camp in the Priest River Valley, was regularly infected every year since its discovery in 1914. The rust was not present on any other tree in the neighborhood. The sporadic appearance of the rust on isolated trees makes it of little or no consequence as a disease to be combated.

The nature of the telia of this rust was demonstrated by the following experiment.

On June 12, 1917, the writer, assisted by E. E. Hubert, made hanging drop cultures in distilled water with fresh teliospores taken from newly ruptured pustules on *Picea engelmanni*. Within three days the teliospores had germinated, produced 4-celled promycelia, and developed sporidia. These sporidia were fairly large, globoid, with cell contents of an orange-yellow color. The teliospores were found to consist of a series of cells produced in succession toward the apex, usually of a characteristic, oblong, parallelogram or fusiform shape, and were arranged catenulate within the sorus. Using the germinating telia from the cultures, 2 inoculations under control were made on June 15, 1917, upon young needles of 2 seedlings of *Picea engelmanni* in the greenhouse. On July 30, 1917, yellow banded areas appeared upon a few of the needles of the inoculated plants. By the last of September of the same year these infections developed sufficiently to distinguish the telial layer. Pycnia were not developed. This experiment demonstrates clearly the autoecious nature of this rust.

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CHRYSOMYXA WEIRII JACKSON

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EXPLANATION OF PLATE 17

Material prepared by the writer and photographed with the assistance of A. S. Rhoads.

Fig. 1. Telia of *C. weirii* on leaves of *Picea engelmanni.*

Fig. 2. Teliospores of *C. weirii.* × 532.

NOTES AND BRIEF ARTICLES

(Unsigned notes are by the editor)

Mr. G. R. Bisby, Professor of Plant Pathology at Manitoba Agricultural College, has returned to Winnipeg after a year spent at the Imperial Bureau of Mycology, Kew, England, where he was associated with Dr. E. J. Butler.

Interesting fungi cultivated by ants are illustrated and described in a popular way by Prof. W. M. Wheeler in one of his series of articles on "Social Life Among the Insects," published in *The Scientific Monthly* for December, 1922.

Dr. Murrill was awarded a gold medal by the Holland Society of New York at its annual meeting at the Hotel Astor on March 6 in recognition of his distinguished service in the science of Mycology. After the presentation, he gave an illustrated address on "Fungi and Their Relation to Forestry in America."

Trachysphaeria fructigena is described by Tabor and Bunting in the January number of the *Annals of Botany* as a new genus and species of the Peronosporineae, responsible for a disease of cocoa and coffee fruits in the Gold Coast Colony. Full descriptions, notes, and illustrations are given of the various stages of this interesting new fungus.

An extensive, splendidly illustrated paper on "The Laccarias and Clitocybes of North Carolina," by Coker and Beardslee, appeared in the *Journal of the Elisha Mitchell Scientific Society* for September, 1922. With this excellent paper before him, the student of the Carolina fungi need have little difficulty in recognizing at least the principal members of this large and difficult group. Four species are treated by the authors under *Laccaria* and twenty under *Clitocybe*.

Dr. G. R. Lyman, plant pathologist of the U. S. Department of Agriculture, has been appointed Dean of the College of Agriculture of West Virginia University, at Morgantown, where he will have supervision of the three divisions of agricultural work of that institution, which include the resident instruction in the College of Agriculture, the work of the Agricultural Experiment Station, and that of the Extension Service.

Officers for the western division of the American Phytopathological Society, which met in Salt Lake City, were elected for the coming two years as follows:

President, S. M. Zeller, Oregon Agr. College, Corvallis, Oregon; vice-president, J. P. Bennett, Univ. of California, Berkeley, Cal.; secretary-treasurer, C. W. Hungeford, Univ. of Idaho, Moscow, Idaho; councilor, representing the Pacific Division, F. D. Heald, Washington State College, Pullman, Wash.

"British Basidiomycetae," a handbook of the larger British fungi by Carlton Rea, recently appeared from the Cambridge University Press. It is a book of 800 pages of text, containing no illustrations, but with keys and carefully drawn descriptions of the 2,546 species of fungi included in all groups from *Clathrus* to *Calocera*. Mr. Rea has long been active in mycology and is considered the best authority in England on the so-called higher fungi, to which the gill-fungi, polypores, and puffballs belong.

Weir reports in *Phytopathology* for April, 1923, a number of species of *Polystictus* which have been observed to attack the sapwood or heartwood of living trees; among them *P. abietinus, P. biformis, P. cinnabarinus, P. floridanus, P. hirsutus, P. lacteus, P. pargamenus, P. pinsitus,* and *P. versicolor.* Most of the species, according to Weir, are of little importance on living trees, and the same he holds to be true of *P. conchifer,* in spite of recent statements to the contrary.

Farmers' Bulletin 1058, by E. C. Stakman, is a powerful argument for the thorough eradication of all our common cultivated

barberry bushes as a protection against wheat rust. In 13 states its destruction is now required by law. The Japanese barberry, *Berberis Thunbergii,* which grows rapidly and does not harbor the rust, may be planted in the place of *Berberis vulgaris.* It is a small shrub, with entire leaves and with berries in ones or twos instead of in bunches. Our native barberry, *Berberis canadensis,* which is fortunately confined to only a few regions, is also dangerous to wheat and should be eradicated along with the European species.

Mrs. Flora W. Patterson retired from active service in the Bureau of Plant Industry at Washington on April 20, 1923, and Dr. C. L. Shear was designated to fill her position as mycologist in connection with the work of the Plant Disease Survey. Dr. Shear sailed for Europe on May 5 to attend the Pasteur Centennial Celebration, the International Agricultural Congress, and the International Phytopathological Conference. He also expects to purchase specimens of fungi for the mycological herbarium in Washington, and to make a study of *Phomopsis Pseudotsugae,* both in the field and in herbaria. He will probably remain in Europe until the latter part of August.

A bulletin by Ray Nelson on mosaic diseases, of great importance and significance, appeared in March as Technical Bulletin 58 of the Michigan Agricultural Experiment Station. The following statements appear in the author's summary:

"Using modern cytological methods, protozoan killing and fixing solutions and protozoan stains, an intensive study has been made of bean mosaic, clover mosaic, tomato mosaic and potato leaf-roll. Definite protozoan organisms, located mainly in the sieve tubes and sieve parenchyma, have been demonstrated to be constantly associated with these diseases.

"The bean and clover organism is a biflagellate, elongated protozoan whose generic position is near Leptomonas. It apparently is a flagellate of new generic rank, since the location and attachment of the flagella differ from the structure in any known genus.

"The organisms found in mosaic tomato plants apparently are

trypanosomes, or are closely related to this genus. They have been found only in the sieve tubes. Their size varies from 6 to 30 microns in length and from 0.5 to 6 microns in width.

"In the sieve tubes of potato leaf-roll plants, organisms have been found which more closely resemble trypanosomes than any other form. They are usually closely associated with the host-cell nucleus. These organisms are also variable in size, some individuals being less than 1 micron wide and 12 long, while the longest one measured was 35 microns.

"All of these organisms lie in a plane parallel to the long axis of the cell and have been demonstrated only in longitudinal sections."

Mr. H. C. Beardslee wrote me from Perry, Ohio, on July 30, 1922, and enclosed some observations on two species of gill-fungi which will be interesting to mycologists:

"*Agaricus distans* grows here, and is at times quite abundant. I find it in a cool ravine near Cleveland, especially late in the fall. My plants in the young stage are brightly colored and are one of our most beautiful agarics. In this stage the color is exactly as Overholts gives it for his plants. The older plants were often duller, lacking the bright colors of the young plant entirely. My observations seem to indicate that the variety is not of much value.

"I have *S. umbonatescens* from this region also. I am interested in one matter in regard to this that does not seem to have been commonly noted. I found at Asheville a plant which seems in some ways different. In general appearance it was much like Peck's species, but the color was not the same. It was more of an umber than a yellow. The spores were distinctly smaller and I found it invariably with a large sclerotid tuber. No one seems to mention any such tuber in our common species, and I am curious in regard to it. I am sending a photo which shows the marked appearance. I have never found *S. umbonatescens* Peck with any such tuber, and have seen no reference to such a character by any other collector. I am wondering if we have two distinct species."

He also enclosed a colored photograph of a species of *Stropharia* which he found only once at Asheville, North Carolina, the descrip-

tion of which he thought agreed fairly well with my *S. elegans*, except that it did not have a bulbous base. He was unable to get at his specimen at the time, but his photograph appears to me to agree rather with *Stropharia rugoso-annulata* than with *S. elegans*.

Dr. H. D. House, State Botanist, has just completed a valuable index of 130 typewritten pages to the 32 notebooks of Dr. C. H. Peck, covering the period from 1868 to 1913, when Dr. Peck's active botanical labors ceased. Three copies of this index were prepared, which are deposited for consultation at the State Museum in Albany, at the Division of Mycological Collections in Washington, and in the Mycological Herbarium of the New York Botanical Garden. In the preface to his index, Dr. House makes the following interesting statements:

"Investigators in mycology who have had occasion to refer to Doctor Peck's types or other collections have often commented upon the fact that his published descriptions and reports of species already published do not give the year of collection. This is explained in large part by the fact that the species described were collected during the year for which the publication is the annual report. Very rarely does he report upon any collection except of the current year, the various monographs of course excepted. These monographs were largely if not wholly a compilation of his former reports and published species, without much reference to the considerable mass of undetermined material of those groups which were stored away in bundles. This is well illustrated by Kauffman's critical study of Peck's material of the genus *Inocybe*.

"In his notebooks, Doctor Peck described under tentative names a very large number of fungi which his critical judgment did not permit him to publish for one reason or another. Without doubt many of these are valid as well as unpublished species. Since the notes were made almost without exception from fresh material they possess a considerable value to the later students of those groups. In addition, his notes upon many well known as well as little known species, made from fresh material and never published, may undoubtedly be of assistance to other investigators, and largely for this reason has the present index to his notebooks been

compiled. Investigators working at Albany may have access to these notes. Those working at a distance may secure upon application a transcript of such items as are desired. However, unless the material to which the notes refer is quite ample, it is a rule of the N. Y. State Museum not to loan material, especially type specimens."

Phytopathology for January contains abstracts of papers presented at the recent meeting of the American Phytopathological Society at Boston. The growth reactions of certain fungi to their staling products, as investigated by C. Boyle, vary with the organism and the medium used. In the case of *Fusarium* sp. and *Botrytis cinerea,* " inhibition of germination is not caused by lack of nutrient material. The toxic effect is partly due to the presence of thermolabile substances. Precipitation by alcohol deactivates some of the inhibiting factors. Filtration through collodion membrane is partly effective in restoring its germinative capacity to staled Richard's solution, indicating that some of the toxic substances present are colloidal in nature."

Foreign studies of white pine blister rust were made by Perley Spaulding during a period of eight months spent in Europe, where, except in Switzerland and Germany, *Pinus strobus* occurs rather as an ornamental than a timber tree. " The oldest *P. strobus* seen in an infected area were in Switzerland and ranged upwards to 118 years in age. Trees of this species were seen in various countries, ranging in age from 4 to 118 years, that were killed or being killed by the blister rust. There is not the slightest doubt that the largest and oldest trees can and will be killed by it." " Moir in 1920 added *Pinus koraiensis* to the known white pine hosts of *Cronartium ribicola,* leaving but four species not known to be attacked. Since then *P. strobiformis* has been inoculated in the greenhouse and *P. balfouriana* has been doubtfully reported as infected in Europe. During the present studies *P. albicaulis* was found in England bearing pycnia and one aecium."

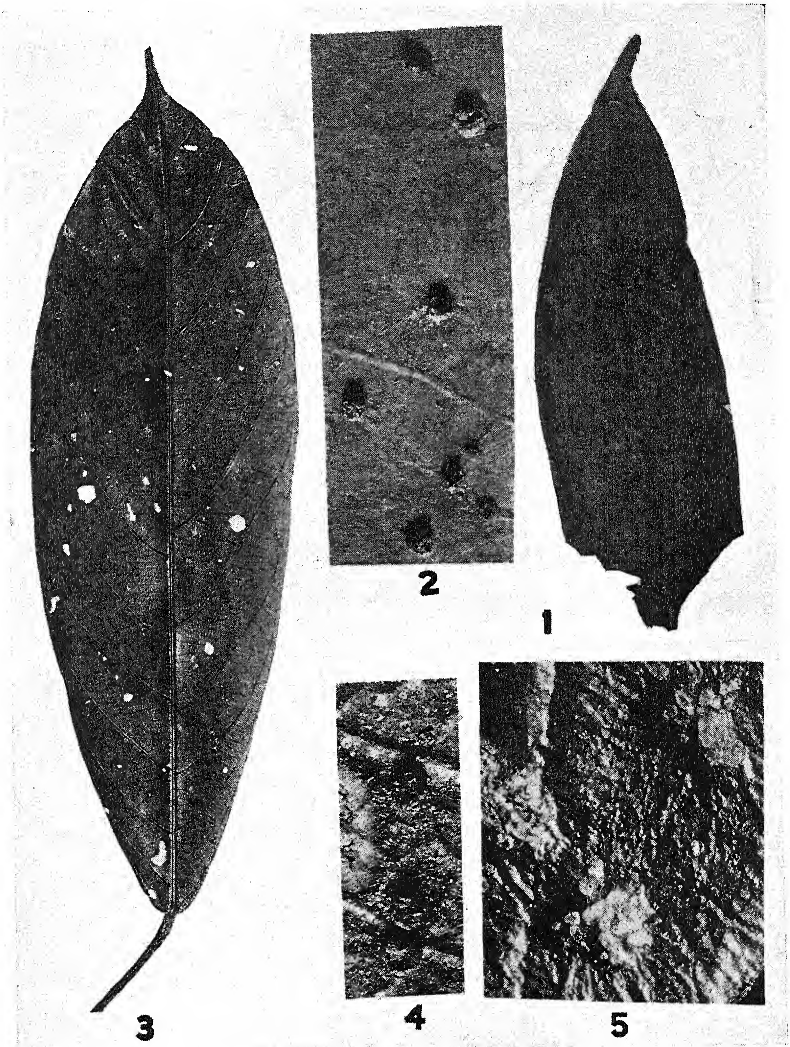
Speaking of the introduction of the white pine blister rust into the Northwest, Dr. Haven Metcalf made the following statement: " The oldest infected (1910) pine wood found at Vancouver, B. C.,

indicates that Vancouver was the place first infected. Records are clear as to importation of *Pinus strobus* from Europe to Vancouver at this time. On the other hand, it is not impossible that there were independent introductions of the disease on Ribes as well as pine at other points, both in British Columbia and in Washington. Both hosts were introduced independently at many places before quarantines were in effect in either the United States or Canada, and it would be strange if some of these introductions were not diseased. The disease now extends north (on pines and Ribes) to the limits of *Pinus monticola,* east (on pines and Ribes) to Beaton, B. C., and south (on Ribes) to within 25 miles of the Columbia River at the coast, thus occurring within a triangle of country 425, 320, and 315 miles on a side. The heaviest spread has been northward, due to climatic conditions and greater abundance of cultivated black currant in British Columbia. Serious local damage to *Pinus monticola* has already occurred. This host appears to be somewhat more susceptible than *P. strobus,* but aside from this fact the disease apparently behaves much as in the East."

The Melanconis disease of the butternut, according to Dr. A. H. Graves, " is characterized in its first stages by the appearance of dead limbs besprinkled with small black acervuli of the causal fungus, *Melanconis juglandis* (E. & E.) comb. nov. Occasionally the acervuli develop spore horns, but are usually rounded or wart-like, and in wet weather like drops of thick ink. This conidial stage has been known as *Melanconium oblongum* Berk. The ascospore stage, which may appear late near these same pustules, has been known as *Diaporthe juglandis* E. & E., but by culture work this is now definitely proved to be the perfect stage of *Melanconium oblongum* Berk. Inoculation experiments, extending over a period of more than four years, have conclusively demonstrated that the fungus is a weak parasite. Entering usually through small twigs by way of a wound, the mycelium grows slowly down through the wood—faster if the tree is already weakened—to the main branch and finally to the trunk. Ordinarily the progress of the disease is so slow that the leaves fall one by one, not producing any striking wilting or blighting effects. In final stages affected trees have a marked stag-headed aspect. Diseased branches should

be pruned off promptly some distance below apparent infection and the wounds tarred over or painted. After the fungus has penetrated the trunk no remedy is practicable."

The camphor disease of Florida was partly cleared up by Mr. N. O. Howard, who attributed it primarily to a species of thrips, *Cryptothrips floridensis*. "Certain camphor growers, however," according to Mr. Howard, "regard the thrips injury as merely incidental to the attacks of a fungus, the latter being the really destructive organism. An undescribed species of Pestalozzia was found to be quite constantly associated with the thrips injury. Moreover, evidence was obtained indicating that the thrips is partly responsible for dissemination of the Pestalozzia spores. Inoculation experiments, however, conducted in the greenhouse upon camphor plants entirely free from thrips indicate that, under these conditions at least, this *Pestalozzia* sp. is unable to attack the healthy tissue, but develops readily in dead portions of the host. It appears, then, that this fungus is a saprophyte or, at the most, a weak wound-parasite upon *Cinnamomum camphora* Nees & Eberm. and that control of the disease lies in the elimination of *Cryptothrips floridensis* Watson."



NEW MYRIANGIACEOUS FUNGI

MYCOLOGIA

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THREE NEW MYRIANGIACEOUS FUNGI FROM SOUTH AMERICA

F. L. STEVENS AND AMY G. WEEDON

(WITH PLATES 18–20)

The fungi here described were found by the junior author in microtome sections made for the study of other fungi on the leaves, and for which the specimens were collected in British Guiana during the summer of 1922. Though the presence of these Myriangiaceous fungi was not recognized until the microtome sections were examined, due to the superficial resemblance of them to the other fungi upon the leaves (in one case, *Endodothella Tapirae;* in the others, *Phyllachora* and *Echidnodella*), once it was known they were there, they could easily be distinguished under the hand lens, or even without it. Descriptions of the fungi follow, also a discussion of their taxonomic position. Specimens are deposited in the herbarium of the University of Illinois and the New York Botanical Garden.

Myrianginella Stevens & Weedon, gen. nov.

Myriangiaceous; stroma developing within the host and erumpent, producing a superficial, irregular excrescence with undifferentiated surface. Asci at different levels, separated by mycelial pseudoprosenchyma. Spores muriform, hyaline. Distinguished from *Myriangina* by the superficial development of its ascoma.

Myrianginella Tapirae Stevens & Weedon, sp. nov.

Figs. 1, 2, 6–9

The fungus appears as small, reddish-brown excrescences, which vary in size from 0.1 to 0.25 mm. in diameter; the leaf being pale-yellow for a distance of 0.5 mm. surrounding them. The spots

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are visible from both sides of the leaf, and, as a rule, the fungus appears on both sides of the spot. The ascoma is undifferentiated on its surface, slightly mushroom-like, enlarging to a greater diameter after it emerges above the leaf surface; total diameter 327–374 μ. A double ascoma measures upward to 468 μ in depth; a single ascoma 312 μ deep and often bears a basal clypeus which is from 31–78 μ in thickness. Asci ovate, 36–43 x 25–36 μ, scattered, heavy-walled, separated by pseudoprosenchyma, not by paraphyses. Spores clavate-oblong, larger at one end, muriform, having several transverse septa, and at the broader end one or more vertical septa. Spores 18–22 μ long by 7 μ wide at their widest point, hyaline, thick-walled.

On *Tapira* sp. British Guiana: Kartabo, 7–22–22, No. 525. The same specimen bears also *Endodothella Tapirae* Stevens.

The specimens were collected for the black dothideaceous *Endodothella* (Figs. 1, 2), and it was at first thought that the red-topped fungi also on the leaf pertained to this fungus. It was only upon examination of microtome sections that the actual presence of two fungi was revealed.

Usually the fungus appears on both sides of the leaf, forming a double ascoma, Fig. 7; when on only one side, Figs. 6, 8, it is a single ascoma. The portion of the stroma near the center of the leaf is usually sterile and is composed of very fine hyaline threads. The riper asci are always near the surface. As many as twenty-five have been seen in a single vertical section of a double ascoma. The youngest are found near the center of the leaf in double ascomata and near the base in single ascomata. The stroma is a very light brown toward the surface, but is not at all differentiated into a cortical layer. Deeper and at the center it consists of a thin, hyaline mycelium. Frequently in double ascomata there is a region midway between the two surfaces of the ascoma where the mycelium is quite dark, while in single ascomata a border of such dark mycelium may surround the ascoma on all sides and on the bottom, though not on the top, giving the whole structure much the general appearance of a cluster cup, Fig. 6. The epidermal cells, below the base of a single ascoma, are usually filled with these dark hyphae, forming a true clypeus, and a considerable cavity, up to 70 μ thick, may exist in the palisade tissue, between this clypeus and the dark basal layer of the ascoma, this space

being filled with the typical hyaline, thin mycelium of the ascoma, Fig. 6. The palisade cells in these regions are disorganized and filled with mycelium. Outside of the region bounded by the dark mycelium and extending for a considerable distance (70 μ) into the host is found the normal, fine, hyaline mycelium.

Scattered throughout the ascoma are spherical, thick-walled asci, Fig. 9; mature ones at the surface, young ones below. When these asci are crushed a mass still resembling an ascus and bearing spores is expelled (Fig. 9). This measures from 67–70 by 17–28 μ, and appears to have a definite wall of its own. When stained lightly with iodine the spores became straw-colored, the inner spore envelope dark brown, and the ascus pale yellow.

It is probable that the double ascomata are formed by the rupture of the basal boundary of a single ascoma in the central portion of the leaf. This boundary, as has been mentioned above, is composed of dark brown mycelium which invades the leaf cells immediately surrounding the lower half of the ascoma. The boundary layer is often found broken, or in remnants, Fig. 6, and extending from it to the opposite side of the leaf can be seen the developing ascigerous stroma. The pressure of mycelial growth is presumably at the center of the base of the boundary layer, for it is here that the break occurs. The second ascoma thus to develop is at first covered with a heavy, brown clypeus composed of the epidermal cells filled with dark brown mycelium. When the second half of the double ascoma has developed, so as to emerge upon the opposite side of the leaf, the clypeus drops off.

Kusanoopsis Stevens & Weedon, gen. nov.

Myriangiaceous. Ascoma from an intramatricular mycelium, erumpent, cushion-shaped, attached by a central foot. Asci at different levels, outer layer not differentiated. Spores muriform, hyaline.

In form of stroma this resembles *Kusanoa*, but differs from it in the absence of a differentiated cortex as well as essentially in spore structure. It also resembles *Dictyonella erysiphoides* (Rehm.) v. Höhn.[1] in the form of the ascoma, but differs from

[1] v. Höhnel, F., Fragmente zur Mykologie, 6. Sitzber. d. k. Akad. d. Wissenschaft in Wien. Math.-nat. Kl. 118: 369 Ab. I. 1909.

it in that our fungus has the asci in several, not one, layers, and still more essentially in several other characters.

Kusanoopsis guianensis Stevens & Weedon, sp. nov.

Figs. 3, 4, 10–15

Spots 0.25–1 mm. in diameter, dull-black, surrounding leaf faint pink for a distance of 1 mm.; usually epiphyllous, occasionally hypophyllous. Ascoma superficial, resembling a mushroom, top lifted above leaf surface on a stalk which extends into the mesophyll. Surface undifferentiated. Asci in upper four fifths of disk, lower fifth sterile, 4-spored, ovoid, 28 x 21–24 μ, thick-walled, hyaline. Spores hyaline, 18–22 x 7–8 μ, muriform with usually 3 transverse septa and 1, 2 or 3 longitudinal.

On unknown dicotyledonous host. British Guiana, Coverden 8-4-22, No. 818.

The same specimen bears also *Phyllachora* No. 3. The specimens were collected for the *Phyllachora* (Figs. 3, 4), which is relatively conspicuous, owing to its shining black clypeus. The myriangiaceous fungus is dull and is brownish rather than black and slightly smaller than the *Phyllachora*.

The ascoma is mushroom-shaped and has a foot in the center which extends above the leaf surface, so that the ascigerous portion is distinctly superficial, raised, free above the leaf, Figs. 10–14. The foot may extend merely into the mesophyll, Fig. 11, or in older specimens, in more or less disorganized manner, it may reach to the opposite side of the leaf, Fig. 13. It varies in width from 31–265 μ, and is composed of heavy, dark-brown, mycelial threads, which in the upper part run parallel and close. At the bottom of the foot the mycelial arrangement is more irregular, less parallel.

The ascigerous stroma, that part supported above the leaf, is somewhat disc or cushion shaped, 202–561 μ in diameter, and from 109–171 μ in thickness. It is of pseudoparenchymatous structure, composed of hyaline, thin mycelium. The upper surface shows no indication of differentiation into a cortex, though there is differentiation of a basal layer of the ascoma, and the edges of the ascoma are composed of darker, thick-walled cells, Fig. 12. The upper portion of the ascoma bears numerous asci; the riper ones

being nearest the surface, the youngest lower down, while the lower fifth of the stroma is sterile. The apparent double-wall character of the asci mentioned for the last species is also seen here (Fig. 15).

An especially heavy, black mycelium is seen penetrating the palisade cells or mesophyll near the leaf surface at the right and left of the foot and under the shadow of the ascoma which is above the leaf, Figs. 12, 13. In some instances the epidermal cells are packed with this black mycelium, Figs. 10, 11, constituting a true epidermal clypeus. Study of the ascomata of all ages makes it appear probable that there is first a large stromatic development in the leaf, followed later by the emergence of the ascoma, Fig. 11. A fine, hyaline mycelium is seen wandering throughout the leaf at long distances from the original place of the infection.

Myriangina miconiae Stevens & Weedon, sp. nov.

Figs. 5, 16–18

Spots 1–2 mm. in diameter or by coalescence 3–4 mm., gray to white, due to numerous microscopic ascomata. Spot visible from both sides of the leaf; convex above, concave below. Fungus epiphyllous. Stromata erumpent, flat, 28–56 μ high, 74–193 μ wide. Surface not differentiated. Asci usually in a single layer, though not always so, separated by a pseudoprosenchyma, few, small, oval, 21–32 x 18–21 μ, 2–3- or 4-spored, hyaline, thick-walled. Spores 18 x 7 μ, hyaline, slightly larger at one end; 3 transverse septa, one or more longitudinal septa; constricted at the middle septum.

On *Miconia* sp. ind. British Guiana, Tumatumari, 7–11–1922, No. 174; Demerara-Essequibo R. R., 7–15–1922, No. 332. The same specimen bears a species of *Echidnodella.*

The spot viewed from above shows the cuticle wrinkled radially about it for a distance of 3–5 mm. due to the tension caused by the elevation.

In all instances observed the *Myriangina* was associated with, or on a spot where *Echidnodella* was or had previously been. In many instances the *Echidnodella* was found free of the *Myriangina,* while in other cases the *Myriangina* was present in abundance with its ascomata, apparently on the surface of the *Echidnodella.*

In other instances the spot bore many ascomata of the *Myriangina* with only traces of the *Echidnodella*. From our observation it appears that the *Myriangina* is necessarily associated with the *Echidnodella*, though our sections show that it is really parasitic on the leaf. Probably the lesions of the *Echidnodella* provide the conditions necessary to parasitism. It is probable also that the *Myriangina* breaking through the cuticle causes the *Echidnodella* to flake off, thus explaining the colonies in which this is nearly absent.

The stroma of the *Myriangina* consists of two portions, the ascigerous, flat disk and a slightly developed hypostroma. Both are composed of fine, hyaline mycelium. The hypostroma consists of a very slight stromatic massing of mycelium between the palisade cells, Fig. 16, and of mycelium which wanders to some distance (193 μ) between the cuticle and the epidermis and between the epidermal cells, also to a slight extent intercellularly into the mesophyll. Though the epidermal, palisade, and mesophyll cells that are surrounded by mycelium by their staining reactions give evidence of abnormality of disease, Fig. 16, the mycelium does not appear to enter the cells. In young ascomata the asci are few, 1–4 in a sectional view; in older ascomata as many as eight were seen. Usually the asci are in a single layer at about the level of the normal epidermis, so that they appear to be resting on the palisade cells. Asci are also frequently seen above the level of the cuticle and are rarely found in the intramatricular hypostroma.

This fungus, with the intramatricular stroma of undifferentiated surface, clearly belongs to the Protomyriangiaceae of Theissen and Sydow and to the Elsinoëae, where its muriform spores place it in the genus *Myriangina*, in which but one species *M. mirabilis* (P. Henn.) v. Höhn. on *Lauraceae* is recorded, and that from Brazil. This species (= *Dictyomollisia albido-granulata* Rehm.)[2] differs from ours in many ways.

These three fungi are of rather exceptional interest because of the problematic relationship of the Myriangiales to other fungi, as well as to the comparative rarity of members of this order and consequent lack of information regarding it. In "Die Natürlichen

[2] Theissen, F. Fungi riograndenses. Bot. Cent. Beihefte, 27; pt. 2. 406. 1910.

Pflanzenfamilien" of Engler and Prantl they are presented in 1896 as Myriangiaceae, by Fisher, as an "anhang" to the Plectascineae, the group then consisting of but one genus, *Myriangium* Mont. & Berk, with but three species; this genus being based on the type species *M. duriaei* Mont. & Berk. The group was characterized by them essentially as with many "Fruchtkörper" in a stroma, asci scattered, spores muriform. In 1917, in the Synoptische Tafeln,[3] Theissen and Sydow recognize the order Myriangiales of Starbäck [4] and place in it 6 families containing 16 genera and some 40 species. Their characterization of the order is a little broader than that given above, in that the fungi are described as immersed or erumpent-superficial; the stroma either colorless or dark, with or without a differentiated outer layer; and no limitation was placed on the spore septation.

It is noteworthy that a great preponderance of the species then known are tropical, with very few from subtropical regions; also that a large number of species are recorded from South America. In 1918 the same authors [5] place the Myriangiales coördinate with the Dothideales and Pseudosphaeriales in the "Dothidiineae."

The three species that we describe are typically of the Myriangiales, in that the asci are produced singly, scattered, and in a stroma. Theissen and Sydow [6] divide the order into two suborders and numerous genera as follows:

A. Fruchtkörper intramatrikal, ohne begrenzte Ausdehnung. Protomyriangieae Theiss. & Syd.
- (*a*) Stroma farblos plektenchymatisch, nach aussen nicht differenziert .... 1. Elsinoëae.
- (*b*) Stroma farblos plektenchymatisch, durch eine dunkle Klypeus-artige Deckschicht nach aussen abgegrenzt .... 2. Plectodiscelleae.

B. Fruchtkörper vorbrechend-frei, bestimmt geformt, allseitig differenziert .... Eumyriangieae Theiss.
- (*a*) Stroma homogen, farblos sklerotial, aussen-nur von schwarzem hartem Schleim überzogen ... 3. Myxomyriangiaceae.
- (*b*) Stroma nicht schleimig inkrustiert, mit differenziert-zelliger Aussenschicht.

[3] Theissen, F. and Sydow, H., Synoptische Tafeln. Ann. Myc. 15: 433, 1917.

[4] Starbäck, Bihang k. Sv. Vet. Akad. Handl., 25 III, 37, 1899.

[5] Theissen, F. and Sydow, H. Vorentwürfe zu den Pseudosphaeriales. Ann. Myc. 16: 6, 1918.

[6] Theissen, F. & Sydow H., l.c.

I. Intertheziales Stroma zellig.		
1. Schläuche mehrreihig	....	4. Myriangiaceae.
2. Schläuche einreihig	....	5. Saccardiaceae.
II. Intertheziales Stroma paraphysenartig	......	6. Dothioraceae.

Our three species agree in having muriform spores and in that they possess a more or less richly developed intramatricular stroma and mycelium, and that on the exposed outer surface there is no differentiated cortical layer. These latter characters lead us to place all three in the suborder Protomyriangiaceae Th. & Syd. and in the family Elsinöeae.

Theissen and Sydow in their key for separation of this order into suborders, and in their discussion of the characters of the families, lay particular emphasis on the statement that the Elsinöeae are devoid of a differentiated surface layer, while the Plectodiscelleae have such. This distinction, so far as the Plectodiscelleae is concerned, is fully borne out by a study of the figures and descriptions of the two species of that group. The wording of their key also calls, in the Eumyriangieae, for an erumpent ascoma with differentiated surface. None of our three species is differentiated on the surface, while two of them only are erumpent, thus seemingly excluding all of them from this suborder. The only remaining family for consideration is the Elsinöeae, characterized by lack of surface differentiation, thus agreeing with all our forms, but also characterized by an innate ascoma. The application of this character would admit one of our species, specimen No. 174, but would exclude both of the others, which are distinctly erumpent-superficial. Thus, under the present systems of classification, two of these fungi are without adequate family. All three of our fungi agree so closely in spore characters, in having an indefinite, undifferentiated surface, in mycelial characters, and in having the asci at several levels, that it appears to us that they are genetically closely related, and that to place them in separate families or suborders would do violence to the natural relationships. If all are to be placed in one family, it must be in the Elsinöeae, with which family they are most closely related in the general summation of their characters. To admit these fungi into the Elsinöeae, the description of the family must be emended to include erumpent

forms, making the distinctive character the undifferentiated surface.

The asci in two of these species, viz., *Myrianginella Tapirae* and *Kusanoopsis guianensis,* show a peculiar structure, in that when the ascus wall is ruptured the ascospores issue, bound together as though still in an ascus, Figs. 9, 15. Whether the spores are still enveloped in a wall is not certain. If so, they present the rare condition among ascomycetes of an ascus with double walls. Perhaps the condition can be explained by assuming that the epiplasm in the ascus is present in quantity, and that it is the epiplasm that holds the spores together, simulating an ascus in appearance. Study of the figures and descriptions given of other Myriangiales, and study of other species, shows that this ascus character is quite common in this group, perhaps indeed it is characteristic of it. Miles,[7] describing *Myriangium tuberculans,* says:

> "Each locule is lined with a thick, hyaline sheath, inside which occurs a single ascus. When the stroma is crushed and examined under the microscope, this sheath easily separates from the tissue of the stroma and remains about the ascus, giving the appearance of being merely a very thick ascus wall. If the sheath becomes ruptured, however, the ascus immediately expands, chiefly in a longitudinal direction, often to two or two and one half times its original length, becoming oblong, broadly spindleform, or ovate with blunt rounded ends, while the ruptured locule sheath collapses about its base. The ascus wall is quite thin as compared with this sheath."

Millard presents, as figured by Fisher,[8] an ascus with similar appearance and refers to an "innern Membranschicht." Asci with two walls are mentioned and figured by De Bary [9] as occurring in *Sphaeria* and *Pleospora.*

As stated above, the Myriangiales have recently been grouped with the Dothideales. The genus *Kusanoopsis,* in the possession of the clypeus, shows distinct affiliation with Dothideales, as it does also in the dark stromatic border of the ascoma within the host tissue. The two other species show no distinctive dothidiaceous characters, though they do not disagree with some of the genera now included in the Dothidiales in stroma characters.

7 Miles, L. E., A New Species of *Myriangium* on Pecan, Mycol. 16: 77, 1922.

8 Engler and Prantl, Die Natürlichen Pflanzenfamilien 1: *pl. 1.* 320.

9 Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria, pp. 93, 95. Trans. by Garnsey, 1887.

EXPLANATION OF FIGURES

PLATE 18

Fig. 1. Photograph of a leaf showing both *Myrianginella Tapirae* and *Endodothella Tapirae* × 1.

Fig. 2. The two above named fungi enlarged are shown, but even at this enlargement are practically indistinguishable.

Fig. 3. Photograph of a leaf showing *Phyllachora* and *Kusanoopsis guianensis.* Leaf somewhat reduced.

Fig. 4. Photograph showing four stromata of *Kusanoopsis,* much enlarged.

Fig. 5. A portion of the leaf enlarged showing colonies of *Echidnodella* with *Myriangina Miconiae,* much enlarged.

PLATE 19

Figs. 6–9. *Myrianginella Tapirae*

Fig. 6. A single ascoma, with the opening hypophyllous, showing the extension of the ascoma above the leaf, the asci, the lateral and basal border of dark mycelium, the basal clypeus, the space between this clypeus and the basal dark layer, also the diseased palisade cells and mycelium invading the host to considerable distance from the ascoma.

Fig. 7. A double ascoma showing the extension above the leaf surface, the asci, the median region relatively devoid of asci and the irregular bordering of dark mycelium.

Fig. 8. A large flat ascoma.

Fig. 9. An ascus showing shape, heavy wall, and spores; also an ascus ruptured showing two walls.

Figs. 10–15. *Kusanoopsis guianensis*

Fig. 10. A young ascoma, and its supporting stroma.

Fig. 11. Detail of ascigerous region shown in fig. 12, showing lack of surface cortex and the presence of basal and lateral differentiation.

PLATE 20

Fig. 12. Ascoma arising from an epidermal clypeus.

Fig. 13. Section of a stroma showing location of the asci, the foot extending to opposite side of the leaf, and the intramatricular mycelium.

Fig. 14. Diagram showing ascomata on leaf, clypeus, foot, and intramatricular mycelium.

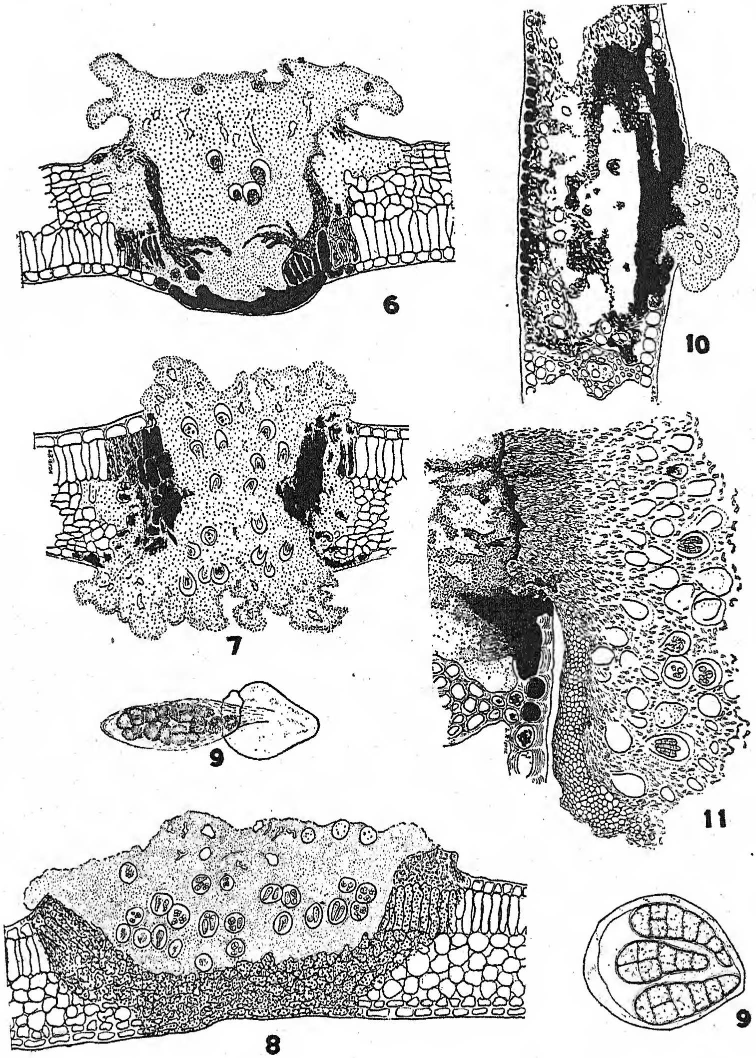
Fig. 15. Asci and spores; also two drawings showing the ascus wall ruptured and the ascus-like body containing the spores emerging.

Figs. 16–18. *Myriangina Miconiae*

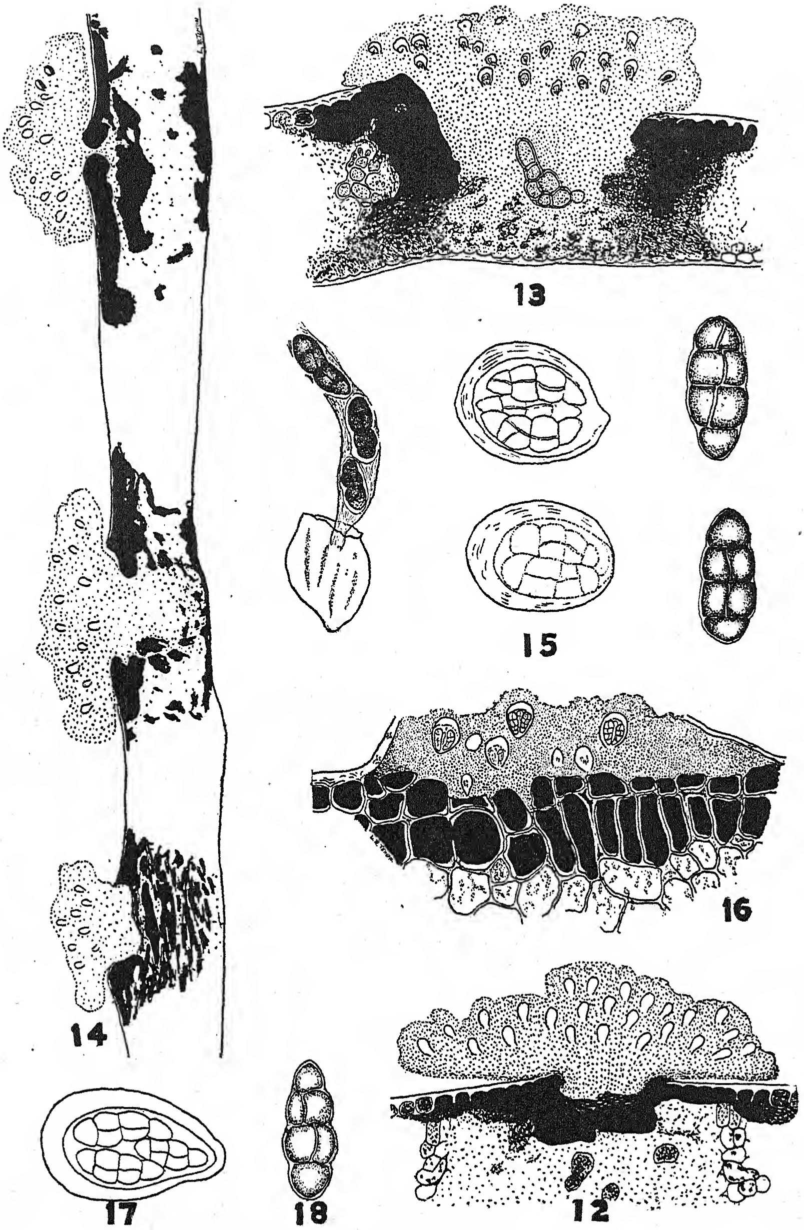
Fig. 16. Section of an ascoma showing it erumpent through the cuticle, the asci, mainly at one level but some between the host cells; the intercellular hypostroma and mycelium subcuticular and between the epidermal and other cells.

Fig. 17. Three asci showing shape, thick wall and number of spores.

Fig. 18. A spore showing shape, septation and constriction.



NEW MYRIANGIACEOUS FUNGI



New Myriangiaceous Fungi

THE SPECIES OF PORIA DESCRIBED BY SCHWEINITZ [1]

L. O. Overholts

(With Plates 21–24)

In his two major publications on American fungi Schweinitz described a total of twenty-two species of resupinate polypores referable to the genus *Poria*. Many of these were described under the generic name of *Boletus* and most of them were transferred to the genus *Poria* by Cooke.

Of these twenty-two species described as new to North America, seventeen are represented by the type collections in the herbarium of Schweinitz. This herbarium came into the possession of the Philadelphia Academy of Natural Science on the death of Schweinitz in 1834 and is still preserved by that institution. The specimens were mounted in their present condition by Ezra Michener about 1855–57, and much of the material was divided at that time, the second part going into the Michener Collection which is preserved in the Mycological Herbarium at Washington, D. C. Other specimens from the Schweinitz Herbarium are said to be preserved at Kew, at Harvard, at Upsala, and in other herbaria.

During the summer of 1921 I spent several days in study of the material at Philadelphia, and in February of this year revisited the collection. I have not studied the material in the Michener Collection, but it contains nothing that is not represented at Philadelphia.

The photographs of the type collections presented here are mostly enlarged to a uniform magnification of one and a half diameters, since this magnification was necessary to bring out the pores of the smallest pored forms. The micro-photographs are all made from free-hand sections and the lack of a uniform excellence in them is due to the fact that type material of this sort is

[1] Contribution from the Department of Botany, The Pennsylvania State College, No. 43.

too valuable for future reference to admit of its being depleted more than is absolutely necessary in an attempt to secure sections that can be photographed under the microscope.

I desire to express my appreciation to the following individuals for courtesies extended and assistance rendered in the preparation of this paper: To Dr. F. D. Kern and the Pennsylvania State College for financial assistance in prosecuting the work; to Dr. W. G. Stone and Dr. F. W. Pennell, of the Philadelphia Academy of Natural Science, for access to the Schweinitz Herbarium and for working facilities in making the studies here recorded; to Mr. W. W. Diehl, of the Office of Mycological Collections at Washington, on whom I have relied for my information as to the contents of the Michener Collection; and to Miss Nell Horner, Assistant Librarian at the Missouri Botanical Garden, for assistance in checking up references and looking up citations in publications not easily accessible to me.

PORIA CANDIDISSIMA (Schw.) Cooke, Grevillea **14**: 109. 1886

Polyporus candidissimus Schw. Trans. Am. Phil. Soc. II. **4**: 159. 1832.

Original Description: P. effusus; membrana tenuissima, bombycina, sed tamen detrahenda. Ad Polystictus pertinere videtur, sed membrana detractabilis obstat.

Rarior ad ligna putrida. Bethlehem.

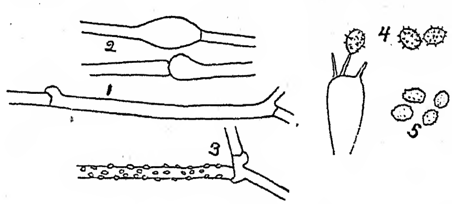
Notes: Only a meager remnant, scarcely one square centimeter, of the type of this species is preserved at Philadelphia. Additional specimens are in the Michener Collection. It is a very thin arachnoid plant, pure white in color when fresh, and soft and flocculent to the touch. The pores are not well developed, but are scarcely more than discontinuous reticulations. Aside from the very thin and delicate fructification the plant has two microscopic characters that are unique and make it recognizable. These are nearly globose, hyaline, *echinulate* spores that measure 2.5 to 4 μ diameter, and the hyphae that occasionally are swollen on one side of a cross-wall to a diameter of 6 to 8 μ. These hyphae are in part minutely incrusted with small crystals and have cross-walls and clamp connections.

I have been familiar with this plant for some time and had kept

it in my herbarium since 1916 without a valid name. In preparing for publication my paper on the Peck Porias I found at Albany one or more collections of the same plant under the manuscript name *P. merulioides* Peck. I adopted this as a herbarium name, although later in referring to Romell's Hymenomycetes of Lapland and to Egeland's Norsk. Res. Poresv., in both of which was described what seemed to be my plant under the name *P. hymenocystis* Berk. & Br., with *P. subtile* as a synonym, I came to the conclusion that my plants should be referred to that species. *P. hymenocystis* is antedated by the present Schweinitzian name. The original brief description of *P. subtile* agrees in most respects and has been used by Bresadola for this plant, yet there are one or two discrepancies that make the use of this name more or less inadvisable. I feel, therefore, that the use of the name *P. candidissima* is conservative practice and can not be criticized from any other standpoint.

A study of the half dozen collections in my own herbarium has yielded the following additional data concerning the species:

The remnants of the Schweinitzian plant (Pl. 21, fig. 1) represent a thin form of the species, which I can match very exactly in collections that contain also much thicker specimens, up to 1.5 mm. (Pl. 21, figs. 2–3). Most of this additional thickness is composed of additional tube lengths, and as the fungus frequently grows in very oblique situations the tubes may appear to be much longer (Pl. 21, fig. 3). The color of fresh specimens is pure white, becoming somewhat yellowish in the herbarium, but usually showing a thin white myceloid sterile margin.



FIGS. 1–5. 1. Hyphae showing branching and clamp connection, from the type specimen of *P. candidissima;* 2. Hyphae from the type collection, showing inflated hyphae; 3. Partially incrusted hypha; 4. Basidium with spores as seen under the oil immersion lens; 5. Spores as seen under ordinary high power magnification.

Cystidia are absent from the hymenium (Pl. 21, fig. 4) and the roughness of the spore wall is in some specimens only indistinctly visible with the high power of the microscope, but comes out well under the oil immersion lens. Vertical sections of the hymenium show that the trama is rather highly crystalline in composition (Pl. 21, fig. 4), and the subiculum next the tubes shows rather heavily incrusted hyphae. No horizontal layer next the substratum is present, nor is there any other marked structural character in this region.

In microscopic features the plant has great similarity to thin lacerate specimens of *Poria radula,* from which coniferous wood collections seem separable on the basis of habitat, while the spores are a constant diagnostic character.

Redescription: Annual, thin, at first in suborbicular patches, flocculent or membranous, only a few centimeters in extent, up to 1 mm. thick, separable from the substratum, but fragile and easily tearing when fresh, with a well-developed, membranous, white mycelioid margin that may in part disappear; subiculum papery thin, white, inconspicuous; tubes unstratified, less than 1 mm. (usually less than 0.5 mm.) long, frequently in oblique situations and with the mouths gaping and becoming lacerate or even irpiciform in spots, pure white when fresh, usually yellowish on drying, averaging 3 to 4 per mm. or somewhat confluent and 2 per mm.; the dissepiments thin and finely ciliate; spores subglobose or broadly ellipsoid, echinulate, hyaline, 2.5–4 μ; cystidia none; trama and subiculum fairly compact, the hyphae hyaline, somewhat branched, thin-walled, with rather inconspicuous cross-walls and clamps, diameter 2–3.5 μ, occasionally with a bulb-like enlargement next a cross-wall, those in the trama and in a layer of the subiculum next the tubes rather heavily incrusted.

On bark or wood of deciduous or coniferous trees, recorded from *Acer* and from *Tsuga.*

Specimens Examined: North Conway, N. H. (two collections); Catskill Mts., N. Y. (in Herb. N. Y. State Museum as *P. tenellus* B. & C.); New York (Herb. N. Y. State Mus., as *P. merulioides* ined.); Angeles Forest, Calif. (two collections, Pomona College Herb. 1503, 1504); also specimen from Sweden, communicated by L. Romell.

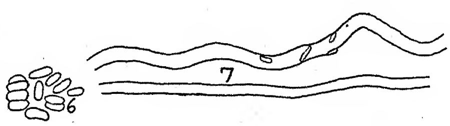
PORIA CARYAE (Schw.) Cooke, Grevillea 14: 111. 1886

Polyporus caryae Schw. Trans. Am. Phil. Soc. II. 4: 159. 1832.

Original Description: P. junior tuberculoso-elevatus, interruptus, substantia spongiosa-tomentosa, margine sterili saepe tumido. Demum late effusa magis aequalibus et subindurescens, margine tunc tenuissimo, submembranaceo, candido, praeditus. Tubis brevibus, parietibus crassiusculis, poris minoribus subrotundis et subflexuosis; interdum regulariter effusis, interdum pulvinatim in tuberculas elevatis. Ex fuliginis cinerascit. Ad pedalem longitudinem sub trunco effusus. In jacente trunco *Caryae albae* Nazareth, longissime effusus polymorphus.

Notes: The types at Philadelphia consist of two specimens, one measuring 4 by 3.5 cm. (Pl. 22, fig. 1) and the other about 2.5 cm. square (Pl. 21, fig. 6). Specimens from the type collection are also preserved in the Michener collection at Washington. The plants are entirely resupinate, the one with a narrow tomentose margin and the other with an indeterminate margin. The smaller specimen has a very irregular hymenium with elevated rounded tubercles, due, I think, mostly or entirely to irregularities of the substratum. The tubes are short and the mouths avellaneous to pinkish buff in color at present, though they probably were white when fresh. Spores are present in abundance in both specimens and have a tendency to cohere in groups of twos and threes as in *P. corticola.*

I have gone over my *Poria* material rather carefully in the hope of finding some collection referable to this species through which its characteristics might be more completely described, but to no avail. Murrill (Mycologia 13: 99. 1921) records it as having been found in Ohio by Morgan; in Ontario, Canada, on beech;



FIGS. 6–7. 6. Spores from the type specimen of *P. caryae,* showing their coherence; 7. Hyphae of *P. caryae*

from Maine; and from Kansas. I have seen none of these specimens. Mr. Lloyd's published suggestion that it may be close to *P. subacida* Peck is without foundation. It appears to me to be closer to *P. corticola* than to any other species, yet the spores (text

fig. 6) seem not to be quite comparable. They are considerably narrower, inclined to be subcylindric and sometimes curved on one side, measuring 4.5 to 6 by 2.5 to 3 μ. Neither are the hyphae comparable (text fig. 7), not possessing the abundant and conspicuous cross-walls of *P. corticola*. Cystidia are present in that species, but I find no trace of them here (Pl. 22, figs. 2, 3). The following description is based entirely on the type material at Philadelphia.

Redescription: Annual, rather widely effused, inseparable (?), at first with a narrow tomentose margin that may disappear; subiculum thin but evident, white; tubes unstratified, 1–2 mm. long, the mouths now avellaneous to pinkish cinnamon though probably gray, white, or sordid when fresh, angular or subrounded, 3–4 per mm.; dissepiments thin but entire; spores oblong or short-cylindric, smooth, hyaline, 4.5–6 x 2.5–3 μ; cystidia none; hyphae flexuous, simple, no cross-walls or clamps, the walls sometimes more or less scabrous, 2.5–4.5 μ diameter.

On rotting wood of *Carya alba.* Nazareth, Pa.

CINERASCENS

Boletus cinerascens Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. membranacea separabilis subtus fusca subhirta expansa confluens, margine involuto poris majusculis obliquis cinereis.

Rarus ad latera truncorum. Papyraseus, a ligno separabilis; margine sterili, involuto, orbiculato confluens.

No specimens are preserved under this name either in the Schweinitz herbarium or in the Michener collection.

PORIA CINEREA (Schw.) Cooke, Grevillea **14**: 111. 1886

Polyporus cinereus Schw. Trans. Am. Phil. Soc. II. **4**: 159. 1832.

Original Description: P. longissime effusus, angustatus, albomarginatus et effiguratus, margine tenui subfimbriato nec tamen byssino. Tubis obliquis brevioribus, poris angustis, subflexuosis. Longitudine 4–6 unciali, 0.5–1 unciali latitudine. Totus unicolor, eleganter cinereus.

Passim Bethlehem ad ramos emollitos. Liriod. et Jugl.

No specimens exist either in the Schweinitz herbarium at Philadelphia or in the Michener collection at Washington.

CROCEUS

Boletus croceus Schw. Naturforsch. Ges. Leipzig Schrift. 1: 96. 1822.

Schweinitz later referred (Trans. Am. Phil. Soc. 4: 158. 1832) this species to *Poria nitida*. No types are preserved at Philadelphia and none are in the Michener collection.

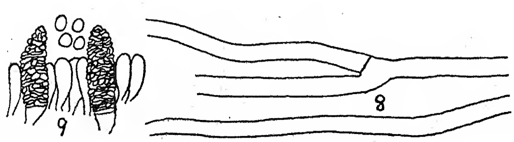
PORIA DECOLORANS (Schw.) Cooke, Grevillea 14: 113. 1886

Polyporus decolorans Schw. Trans. Am. Phil. Soc. II. 4: 159. 1832.

Original Description: P. minutis 3–4 lin. diametro, sed longe lateque confluens, non effusus, sed quasi totaliter affixus, margine inflexo, libero, membranaceo. Primum mollusculus, albus, decolorans ac sordide brunneus devenit. Poris magnis subflexuosis, e forma orbiculari in flexuosam confluit. Tenerrimus.

Rarior bethlehem in cortice dejecto.

Notes: The type material of this species preserved at Philadelphia is very meager, scarcely covering one square centimeter of area, and I did not secure a photograph of it. I am informed that the co-type specimen in the Michener collection is also quite unsatisfactory. Not much aside from microscopic characters can be added to the original description. The macroscopic features seem to be the white color of the fresh hymenium, becoming darker on drying. The microscopic characters include globose hyaline spores of a diameter of 4 to 5 μ (text fig. 9) and nearly simple hyphae with very occasional cross-walls but no clamps, and large in size, running to 5 to 6 μ diameter (text fig. 8); also heavily incrusted projecting cystidia, best developed in the bottom of the tubes and except on very careful examination likely to be passed by as irregular crustals (text fig. 9; Pl. 22, fig. 4). Their diameter is 7 to 10 μ.



FIGS. 8–9. 8. Hyphae from the type collection of *P. decolorans*; 9. Portion of hymenium of *P. decolorans*, showing spores and the incrusted projecting cystidia.

Lloyd has stated that the plant seems to be close to *P. sanguinolenta* A. & S., but I do not judge it to belong to the bright-colored series, unless possibly it be related to *P. rixosa* Karst., which, however, has different spores.

The fungus was growing on a piece of bark and from an examination I am unable to state whether it belongs to a hardwood or an acerous host.

Redescription: Annual, effused in elongated confluent patches, inseparable; subiculum membranous, distinct though thin, pallid; tubes unstratified, very short, white and soft when fresh (fide Schweinitz), discoloring to dirty brown on drying, the mouths angular, thin-walled, entire, averaging 4–5 per millimeter; spores globose, smooth, hyaline, 4–5 μ; cystidia present, heavily incrusted, some imbedded and some projecting somewhat, diameter 7–10 μ; hyphae flexuous, with a staining content, somewhat branched, with occasional cross-walls but no clamps, 5–6 μ diameter.

On fallen wood. Bethlehem, Pa. Not otherwise known.

PORIA FAVESCENS (Schw.) Cooke, Grevillea **14**: 113. 1886

Polyporus favescens Schw. Trans. Am. Phil. Soc. II. **4**: 158. 1832.

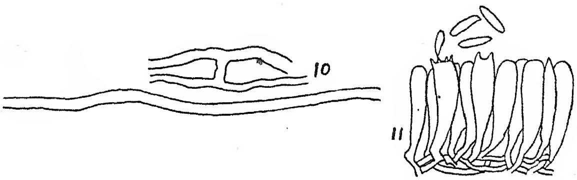
Original Description: P. resupinato-effusus ad pedalem longitudinem, crassus, margine tenui subalbido, determinatim elevato ambitu. Poris latiusculis, hexagonis; tubis longissimis, pallidis.

Non absimilis *P. megalosporo,* Pers. Myc. Eur. 105, differt colore.

Bethlehem rarius in ramis. Favum refert.

Notes: This plant has all the external characteristics of the effused, large-pored type of *Trametes sepium,* as can be seen by a comparison of the two photographs here presented (Pl. 22, figs. 5, 6). The microscopic characters, including spores, size of basidia, and hyphal characters, are exactly as in *T. sepium,* the spores measuring 8 to 9 by 2 to 3 μ (text fig. 11). They were found both free and on basidia. No conspicuous cystidia are in the hymenium (Pl. 22, fig. 7), but an occasional sharp-pointed paraphysis-like body may be found. The basidia are quite large, measuring 6 to 7.5 μ in diameter. The hyphae are long and flexuous, without cross-walls or clamps, rarely branched, and measure 2 to 4.5 μ in diameter (text fig. 10).

It is of interest to note that *T. sepium* was not described until 1847, while Schweinitz's name antedates this by fifteen years.



FIGS. 10–11. 10. Hyphae from the type specimens of *P. favescens*; 11. Basidia and spores from the types of *P. favescens*.

Consequently the priority rule would give preference to the Schweinitzian name, if strictly adhered to. Whether it is wise to attempt to displace old-established names may well be doubted.

PORIA INTERNA (Schw.) Cooke, Grevillea **14**: 109. 1886

Polyporus internus Schw. Trans. Am. Phil. Soc. II. **4**: 159. 1832.

Original Description: P. longitudinaliter penetrans in cavitatibus trunci putridi varie flexuosus ad 3–4 uncias, primo molliusculis, crassus margine demum inflexo. Tubis saepe obliquis longioribus. Poris flexuosis minutis. Color totus albus, nisi statu sicco subpallescit.

Bethlehem passim interiori parte truncorum obvius.

No specimens of this species are preserved either in the Schweinitz herbarium or in the Michener collection.

PORIA JUGLANDINA (Schw.) Cooke, Grevillea **14**: 110. 1886

Boletus juglandinus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. durissima immersa compressa difformis, margine sterili involuto spadiceo-cinerea, poris minutis.

In duris truncis Juglandis nigrae et Platani rarior, fissuris ligni immersus margine involuto, ita ut fere pileum efficiat. Pori obliqui, primo obtutu cinerei, demum subspadicei, nitentes.

Notes: The type of this species is preserved only at Philadelphia and is a small immature specimen that evidently grew on the vertical face of its substratum. Hence the tubes are nearly vertical and very poorly developed. In cross-sections of the tubes the hymenium is only partially developed. No spores were seen on basidia, but a few broadly ellipsoid or globose ones were found free floating in the preparations. A few scattered setae are pres-

ent, however, though they are quite rare. Never more than one showed up in any tube section and many tubes showed none at all. They are of the type of those of *Fomes igniarius,* being dark colored, rather thick and short, and tapering to a rather conical point (Pl. 23, fig. 1).

The context is brown in color and the plant is hard and firm, with a grayish hymenium. Undoubtedly it represents a resupinate condition of some *Fomes,* but the material is too fragmentary for further reference, and too fragmentary to be photographed.

LILACINUS

Boletus lilacinus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 100. 1822.

Original Description: B. P. minor, poris aut cupules magnis flexuosis superficialibus tomento tenui concolori innatis.

Haud rarus in putridis lignis autumno. Unciam longus, totus lilacinus cum proximo medium locum tenet inter Porias et Pezizus.

No specimens of this species are preserved either at Philadelphia or at Washington.

PORIA NIGROPURPUREA (Schw.) Cooke, Grevillea **14**: 110. 1886

Boletus nigropurpureus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. coriaceae effusa durissima, margine inflexuo sterili albescente, poris minutis flexuosis atropurpurascentibus.

Sub truncis *Quercus* rarior, ulna saepe major. Ligneus fere, late effusus.

Notes: The types are all preserved at Philadelphia and include about 2 square centimeters of fungous growth (Pl. 23, fig. 2) fairly well preserved. The general appearance of the plant is of the resupinate condition of *P. adustus,* or following the clue of "atropurpurascentibus" in Schweinitz's description it might be more similar to *P. dichrous,* a species which even in well-developed specimens is sometimes confused with *P. adustus* and *P. fumosus.* The color of the hymenium is now deep mouse gray, and the pores are quite small, averaging 5 to 7 per millimeter, with entire dissepiments. The spores are quite different from those of any of the species named above. They are cylindric (text fig. 12) and measure 5 to 7 by 2 to 2.5 μ, and are plainly to be seen attached

to basidia. There are no cystidia in the hymenium (Pl. 23, figs. 3, 4). The hyphae have inconspicuous cross-walls and clamps and measure 3 to 4.5 μ diameter (text fig. 12). They are rather thick-walled, but the wall is so colorless that this point is not easily made out, though it can readily be seen in the very compact tissue composing the trama as seen in cross-sections of the hymenium.

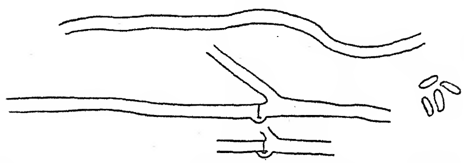


FIG. 12. Hyphae and spores from the type specimen of *P. nigropurpurea*.

The types of this species were collected in North Carolina, but Schweinitz recorded it (Syn. N. Am. Fung. No. 439) also as occurring not infrequently in Pennsylvania. I have seen nothing which I could refer to this species.

Redescription: Annual, apparently separable, without sterile margin; subiculum thin but conspicuous, white, contrasting rather strongly with the dark hymenium; tubes about 1 mm. long, the mouths smoke-colored or deep mouse gray, minute, averaging 5–7 per millimeter, the dissepiments rather thin but entire; spores short-cylindric, hyaline, smooth, 5–7 x 2–2.5 μ; cystidia none; basidia 4–6 μ diameter; hyphae flexuous, hyaline or nearly so though in sections of the trama with a brownish coloration, occasionally branched, with scattered cross-walls and inconspicuous clamps, diameter 3–4.5 μ.

On trunks of *Quercus*. North Carolina, and reported by Schweinitz as occurring also in Pennsylvania.

PORIA PAPYRACEA (Schw.) Cooke, Grevillea **14**: 111. 1886

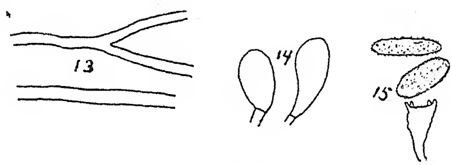
Boletus papyraceus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. membranacea tenuissima sicca adnata candida, poris maximis obliquis pallidis.

Praesertim incolit Vites emortuas. Membrana omino refert Racodium papyraceum. Margine sterilis; in longitudinem expansus.

Notes: The types at Philadelphia cover about three fourths of the upper surface of a bit of wood 5 by 2 cm., and show the fungus

to be a thin white soft species (Pl. 23, fig. 5) comparable to most collections referred to *P. vaporaria* in American herbaria. A narrow white villous margin surrounds the growing edge of the fungus. The fungus seems to be separable from the substratum, and consists of very short pores on an extremely thin white subiculum. Sections of the hymenium show an abundance of cylindric hyaline echinulate spores (text fig. 15). Wall markings of this type constitute a character rarely seen in Porias and yet more rarely found in *Basidiomycetes* with elongate spores, outside of the genus *Clavaria*. Failure to find these spores on basidia has led to the suspicion that they may not belong to the species in question. The hymenium shows basidia-like organs (text fig. 14), but none that are spore-bearing, although sterigmata are present on some, and the general relation and orientation of the spores to



FIGS. 13–15. 13. Hyphae of *P. papyracea*; 14. Large basidia-like organs in the hymenium; 15. Two spores as seen along the hymenium and in proximity to the basidia.

the basidia is suggestive that some of them are attached (Pl. 23, fig. 6). The hymenium is so irregular and collapsed that the point is very difficult to substantiate. When I first observed the spores I recorded in my notes that the markings appeared to be arranged in longitudinal lines, but as I view them now, after a year and a half in glycerine, I fail to substantiate the point and they now appear to be more in the nature of very fine spines, so that the spores might perhaps best be described as spinulose. However, their large size (14 to 18 μ long) and spinulose wall make it seem plausible that they are not basidiospores and might well be the spores of a *Clavaria* or other fungus, scattered over the hymenial surface. Cystidia were not found. As seen in vertical sections much crystalline matter is present in the subiculum next the substratum.

The species is somewhat similar in general appearance to *P.*

candidissima, but the pores are larger and I have found no microscopic evidence of their similarity. I have specimens of a *Poria* collected on *Thuja occidentalis* in New York by Dr. H. D. House that have exactly the type of basidiospore represented here, yet microscopically the two are so different that I hesitate to refer the New York collection to this species.*

Redescription: Annual, thin, white, soft, not widely effused, the margin narrow, white, and villose; subiculum extremely thin, white; tubes less than 0.5 mm. long, the mouths white, cinnamon-buff in dried specimens, subcircular to angular, averaging 2 per millimeter; the dissepiments rather thin, entire; spores (?) not seen on basidia, cylindric, hyaline, spinulose, 14–18 x 5–6 μ; cystidia none; basidia 8–10 μ diameter; hyphae straight, mostly simple, no cross-walls or clamps, diameter 3–4.5 μ.

On dead *Vitis*. Carolina. Not otherwise known to the writer.

PORIA PULCHELLA (Schw.) Cooke, Grevillea 14: 113. 1886

Polyporus pulchellus Schw. Trans. Am. Phil. Soc. II. 4: 158. 1832.

Original Description: P. resupinato-effusus, superficie inaequali, subplicata, rugosa, ambitu determinatus; margine undulato tumido, substerili. Poris minutis, regularibus, angustatis, tubis subobliquis in rugis superficiei. Totus fungus flavescens, durus, siccus, uncialis.

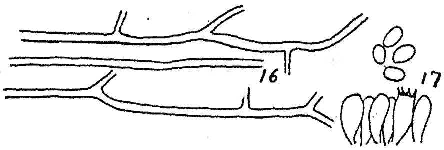
Rarior Bethlehem, olim *Xanthus* mihi; cortice increscit.

Notes: The type collection at Philadelphia is in good condition and specimens are also preserved in the Michener collection. It is one of the few Schweinitzian species that has been correctly interpreted by subsequent mycologists, though the autonomy of the species as distinct from related things has been questioned. Dr. Murrill[1] includes it as a synonym for *P. medulla-panis* (Jacq.) Pers., and that interpretation makes the species a most variable one.

* Since this paper has been in press Dr. J. R. Weir has reported (Phytopath. 13: 187, 1923) *P. papyracea* on *Chamaecyparis thyoides* from Virginia, and on *Thuja* from Wisconsin and from Michigan, describing for it spores as here recorded. It seems quite likely that the New York specimens referred to above belong here, and possibly the substratum for the type of *P. papyracea* was *Thuja* or may be *Juniperus* rather than *Vitis*. A dead branch of juniper in particular might easily be passed up as *Vitis*.

[1] Mycologia 12: 48. 1920.

The types are in excellent condition (Pl. 23, fig. 7) and ample enough to show the characters quite well. Microscopically, oblong-ellipsoid, smooth, hyaline spores measuring 5 to 6 by 3 to 4 μ are present (text fig. 17). No cystidia or sterile bodies of any sort are present in the hymenium (Pl. 23, figs. 8, 9). The basidia are broadly clavate, measuring 5 to 7 μ in diameter. The hyphae are considerably branched and show no cross-walls or clamps. Their diameter is 2 to 3 μ (text fig. 16).



FIGS. 16–17. Hyphae from the type of *P. pulchella;* 17. Basidia and spores

These are all characters that apply to the small-pored form of typical *P. medulla-panis,* except that the hyphae there are 2 μ in diameter or less and the plant is hard, and white in color. Yet the two are so closely related that the one grades insensibly into the other, and *P. pulchella* in turn grades over into a yet softer pliable plant in which the hyphae are practically or entirely unbranched and of considerably larger diameter, so that the whole plant approaches *P. subacida* Peck quite closely.

The following brief diagnosis is meant to apply to the type of plant represented in the Schweinitz herbarium. Its relationships with *P. medulla-panis* will be considered in a later paper.

Redescription: Annual or persisting, broadly effused, separable, 1–5 mm. thick, leathery or tough when fresh; subiculum very thin, floccose, white; tubes 1–1.5 mm. long each season, the mouths cream-color to light tan, circular or subcircular, averaging 5–6 per millimeter; spores oblong-ellipsoid, thin-walled, hyaline, smooth, 5–6 x 3–4 μ; cystidia none; basidia broadly clavate, 5–7 μ diameter; hyphae long and flexuous, considerably branched, no cross-walls or clamps, diameter 2–3.5 μ.

On dead wood of deciduous trees. Frequent in eastern United States.

PORIA RHODODENDRI (Schw.) Cooke, Grevillea 14: 113. 1886

Polyporus rhododendri Schw. Trans. Am. Phil. Soc. II. 4: 158. 1832.

Original Description: P. longitudinaliter effusus; angustatus. Primum observatur membrana papyracea, detractabilis, albescens aut pallescens, in cujus centro pori pauci parum elevati, lati, occurrunt. Demum poris his, tota superficie obsita est, membrana tantum non in ambitu ubi sublifera et subinflexa. Poris tandem in tubos angulatos, margine fimbriatos, 2–3 lineas altos, ex pallide fuscescentes, elevatis. Totus fungus 1–3 uncias longus, ¼ unc. latus, affinis *P. contiguo*.

Notes: The type collection at Philadelphia consists of a single slab of decorticated wood on which is effused a sporophore 4 cm. long by 6 mm. broad (Pl. 22, fig. 8). Another specimen is in the Michener collection at Washington. Lloyd has recorded the observation (Letter No. 50, note 436, 1913) that this specimen is "surely not what Schweinitz described." I find no evidence to bear out this statement, since there is little in the original description that is contradicted by the specimen. The phrase in the description, "affinis *P. contiguo*," is contradicted by the words "albescens aut pallescens," since *P. contigua* is a brown species.

The species seems undoubtedly to be the same as *Trametes sepium*, as is borne out by the following facts. The subiculum is thin and inconspicuous, but white in color and separable from the substratum, bearing tubes 1 to 1.5 mm. long, the mouths of which are angular, and 0.5–1 mm. in diameter (Pl. 22, fig. 8). The dissepiments are thin and somewhat fimbriate. Sections of the hymenium yielded no spores and no basidia. The hyphae (text fig. 18) are of two general types: (*a*) large, simple, hyaline, unstaining filaments which show no cross-walls or clamps and have a

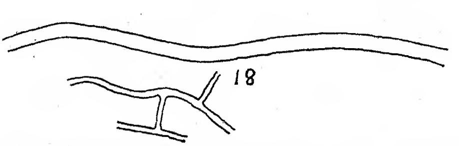


FIG. 18. Hyphae from the type specimens of *P. rhododendri*.

diameter of 3 to 5 μ; (*b*) small, considerably branched, heavy-staining hyphae on which no cross-walls or clamps are visible and of which the diameter is about 2 μ.

These characters are exactly those of *T. sepium,* and so I take Lloyd's opinion that the fungus as now preserved is that species, and without better evidence than seems available I conclude that this specimen is the type from which the description was originally drawn.

The species was originally described as occurring on fallen *Rhododendron* trunks at Salem, N. C.

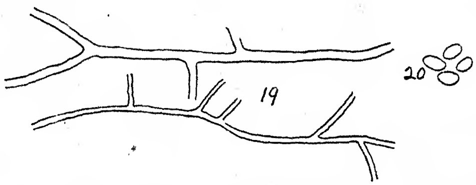
PORIA SASSAFRAS (Schw.) Cooke, Grevillea **14**: 109. 1886

Polyporus sassafras Schw. Trans. Am. Phil. Soc. II. **4**: 158. 1832.

Original Description: P. substantia molliuscula, fibula; subiculo vix in margine conspicuo; tubis in centro satis elongatis, crassiusculis. Poris minutis, regulariter rotundis. Longitudinaliter in ligno ac cortice effusus (colore pallide lutescente) ad 1–2 uncias.

Passim in lignis carie fere consumptis *Sassafras,* Bethl.

Notes: There is some discrepancy between the description and the specimens preserved at Philadelphia. For example, the term "crassiusculis" can not be applied to the dissepiments nor the term "minutis" to the pores.



FIGS. 19–20. 19. Hyphae from the type specimens of *P. sassafras,* showing abundant branching; 20. Spores of the same.

The plant is thin and not widely effused, covering only 4 or 5 square centimeters of wood area (Pl. 24, fig. 1). No specimens are preserved in the Michener collection. One specimen at Philadelphia has a broadly sterile margin, but the subiculum is not conspicuous, though white in color. The color of the hymenium is now close to straw color or yellowish white. I did not succeed in getting sections of the hymenium suitable for photographing. The spores are broadly ellipsoid, hyaline, and measure 5 to 6 by 4 to 4.5 μ (text fig. 20). There are no cystidia. Some hyphae are greatly branched as in *P. pulchella* and lack cross-walls or

clamps. Some are narrow and rigid with a diameter of 1.5 to 2.5 μ, while others are broader, measuring up to 4 μ (text fig. 19).

Redescription: Annual, probably separable, soft and watery when fresh, at first with a broad sterile border that may disappear with age; subiculum thin, white; tubes unstratified, 1–2 mm. long, their mouths white when fresh, becoming yellowish on drying, rounded to slightly angular, entire, averaging 4 to 5 per millimeter; spores ovoid to broadly ellipsoid, hyaline, 5–6 x 4–4.5 μ; cystidia none; hyphae hyaline, much branched, no cross-walls or clamps, diameter 1.5–4 μ.

On decaying sassafras wood. Bethlehem, Pa.

PORIA SPISSA (Schw.) Cooke, Grevillea **14**: 110. 1886

Polyporus spissus Schw. in Fries' Elenchus Fungorum **1**: 111. 1828.

Original Description: Durissimus, immersus, difformis, cinereospadiceus, margine brevissimo inflexo, poris obliquis minutissimis.

Notes: The description and the specimens at Philadelphia do not well accord, although the plants change much on drying, and it may be that the description was made from the dried plants as Lloyd suggests. But "durissimus" is not a good descriptive term to apply to even the dried plants and the color is not "spadiceus." Fries noted that the description agreed entirely with that of *P. juglandina,* but the types of the two have not the remotest resemblance.

The type at Philadelphia is an admirable little specimen with an apricot buff coloration on the younger parts of the dried specimen, while the hymenium is hazel to carob brown. The tubes have a resinous appearance, but have developed no hymenium. No specimens are preserved in the Michener collection.

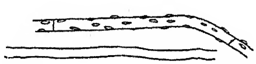


FIG. 21. Hyphae from the type of *P. spissa,* one showing the incrusting crystals.

The entire array of characters presented by the plant is that shown by *P. laetifica* Peck, and the name takes precedence over that given by Peck. Murrill has already come to about the same

conclusion, citing in addition four other names coupled with American plants, as synonyms, all antedated by Schweinitz's name. The description previously given of *P. lactifica* in my writings must suffice for the present time.

PORIA SUPERFICIALIS (Schw.) Cooke, Grevillea **14**: 113. 1886

Boletus superficialis Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. tenuis sicca ferrugineo-cinerascens, poris superficialibus latiusculis prominulis sublaceratis subconfluentibus.

In Pruno silbatica emortua, longe lateque repens. Pori tubis fere nullis, nec margine distincti.

Notes: This is a brown species, but, as often shown in related forms, the hymenium has become grayish with age—so much so that at first glance it impressed me as belonging to the white group, the color being smoke-gray to hair-brown. A sterile, seta-bearing margin surrounds on two sides the excellent little type specimen at Philadelphia (Pl. 24, fig. 2). Specimens are also preserved in the Michener collection at Washington. The subiculum is brown and thin. The tubes are about 1 mm. long, brown within, the mouths angular, variable in size, measuring 1 to 3 per millimeter. Setae are rather abundant in the tubes (Pl. 24, fig. 3), but I found no basidia developed in my sections. The setae are strongly projecting and measure 9 to 12 μ in diameter.

FIG. 22. Single hypha from the type specimen of *P. superficialis*.

The lack of spores makes it a little questionable as to the plant's relationships. Schweinitz gives Fries' comment as ". . . vix conjunxisset cum *P. viticola*. . . ." Berkeley reported it as the same as *P. nigropurpureus*, but it is not that plant, having much larger pores and a distinct brown coloration. Lloyd was inclined to accept Fries' idea, with which I agree. It has the larger pores of *P. viticola* rather than of *P. ferruginosa*, the distinction between the two species being otherwise best made on the spore characters, and those are lacking in the Schweinitz plant. The fact that it was reported as occurring on *Prunus* suggests that it might be *Fomes fulvus*, but the characters are not those of that species.

When sections of the hymenium from the type specimens of *P. superficialis* and *P. viticola* are compared microscopically, there is no distinction between them (Pl. 24, figs. 3, 6). The former antedates the latter by some six years, and if these are not antedated by a prior name, *P. superficialis* should be given preference. Quite probably, however, *P. contigua* Pers. is the same plant, and it has been more recently named both in Europe and in America.

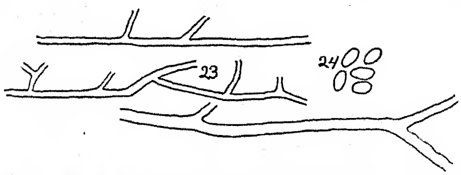
PORIA TENUIS (Schw.) Cooke, Grevillea 14: 114. 1886

Polyporus tenuis Schw. Trans. Am. Phil. Soc. II. 4: 159. 1832.

Original Description: P. longe longitudinaliter effusus, membranam sistens tenuem subdetrahendam albo-pallentem aequabilem margine substerili albidori. Poris majusculis subflexuosis, parum excavatis pallidis.

Ad fibrosam internam corticem Castaneorum. Bethl.

Notes: The type material at Philadelphia shows well the characters of the plant. Specimens are also to be found in the Michener collection. The fructifications have a length of 3 cm. and a width of 1.5 cm. (Pl. 24, fig. 4). The species belongs to the white group and shows a broadly sterile, white, compactly tomentose margin and a very thin white subiculum. The color of the hymenium is now cartridge buff or pinkish buff. Spore and hyphal characters are as in *P. medulla-panis* (text figs. 23–24).



FIGS. 23–24. 23. Large and small hyphae from the type specimen of *P. tenuis;* 24. Spores of the same.

The fungus is certainly a close relative of the above-named species and probably should take its place in the synonymy of either that plant or of *P. pulchella.* I was unable to secure sections suitable for photographing.

Redescription: Annual, effused in elongated patches, separable, with a broad sterile tomentose margin; subiculum very thin, inconspicuous, white; tubes unstratified, 0.5 mm. long, the mouths white, becoming cartridge buff or pinkish buff in herbarium specimens,

angular or subrounded, averaging 4 per millimeter; spores ellipsoid or oblong-ellipsoid, smooth, hyaline, 4.5–5.5 x 3–4 μ; cystidia none; basidia broadly clavate, 6 μ diameter; hyphae mostly rigid, much branched, no cross-walls or clamps, diameter 1.5–2.5 μ, a few somewhat larger and more flexuous, up to 3.5 μ diam.

On decorticated wood of *Castanea*. Bethlehem, Pa.

PORIA TULIPIFERA (Schw.) Saccardo, Syll. Fung. **6**: 312. 1888

Irpex tulipiferus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 99. 1822.

Original Description: B. P. maxime effusa margine involuto tenui albida, poris maximis acutis prominulis asperis irregularibus.

Frequens ad truncos emortuos Liriodendri, ad viginti pedes et amplius, saepe arbores integras circumdans, alias orbiculatus confluens, albus, demum pallidus. Pori interdum in formam Sistotrematis porrestic.

No types of this species are preserved either at Philadelphia or at Washington. As generally interpreted it is a common plant, formerly referred to *Irpex,* but a true polypore, often pileate, and now more generally included in *Polyporus.*

PORIA VITELLINA (Schw.) Cooke, Grevillea **14**: 110. 1886

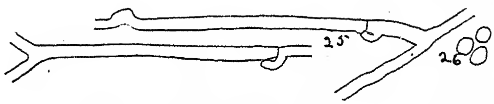
Boletus vitellinus Schw. Naturforsch. Ges. Leipzig Schrift. **1**: 100. 1822.

Original Description: B. P. subexpansa molliuscula, margine byssino, poris magnis elevatis opacioribus.

Rarus fungus in fissuris lignorum, maxine putridorum, nidulat. Color pulcherrime vitellinus, post exsiccationem remanet. Pori molles.

Notes: The type specimens at Philadelphia show very poor material. Others are preserved at Washington. It is apparently a soft yellow species, and the types evidently grew on a vertical substratum. The hymenium is developed only on a small part of the soft extensive subiculum. The former is now orange cinnamon or tawny in color, while the subiculum is cinnamon-buff. The present colors would point to fresh plants having somewhat more red or orange in them rather than egg yellow. The tubes are quite fragile, with mouths averaging 2 to 3 per millimeter. Abundant spores are in the hymenium, but I am of the opinion that they are either chlamydospores or else are foreign to the plant, and they were not found on basidia. They are globose, smooth,

and measure 4 to 6 μ in diameter (text fig. 26). Crushed preparations of the subiculum show an anomalous condition of a few well-developed somewhat branched hyphae, 4 to 4.5 μ in diameter, with very well-formed clamps and cross-walls (text fig. 25). There are present also some very fine hyphae 1 to 2 μ in diameter that probably belong to another organism. I was unable to secure sections suitable for photographing.



Figs. 25–26. 25. Hyphae from the type specimens of *Poria vitellina,* showing clamp connections; 26. Spores found on the hymenium, but not attached to basidia.

I have a similar plant on coniferous wood that I would like to refer here, but a study of the substratum of the type collection shows that it is unquestionably a hardwood. My plants agree otherwise almost exactly, but the spores are oblong-ellipsoid or slightly reniform and apiculate at one end, and measure 5 to 6 by 3 to 3.5 μ. But the different substratum and the lack of basidiospores in Schweinitz's type make such a reference undesirable at present.

Redescription: Annual, effused, soft, bright colored, consisting of a well-formed soft subiculum on part of whose surface tubes are developed; subiculum egg yellow or becoming cinnamon buff on drying; tubes less than 1 mm. long, oblique, the mouths egg yellow (fide Schweinitz), becoming orange cinnamon or tawny in herbarium specimens, averaging 2 to 3 per millimeter; spores (?) globose, smooth, probably bright colored in mass but hyaline under the microscope, 4–6 μ diameter; cystidia none; hyphae not to be easily differentiated in the type specimens.

On rotten hardwood. Carolina.

Poria viticola (Schw.) Cooke, Grevillea **14**: 114. 1886

Polyporus viticola Schw. in Fries, Elenchus Fung. **1**: 115. 1828.

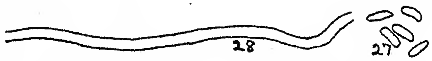
Original Description: Effusus, innatus, glaber, fuscus, poris difformibus, subangulatis, acutis, glabris.

Ad *Vitis* sarmenta. Salemo in Penn. Amer. foed.

Notes: This is a well-known species, but has passed under a

variety of names, of which *Poria contigua* is the oldest. However, no uniformity exists among European mycologists as to the status of *P. contigua*. The types of *P. contigua* Pers. have been studied by Romell, but he reports them as sterile, stating, moreover, that *P. contigua* (Pers.) Fr. is a different (really three different) plants.

The Schweinitzian types are well preserved at Philadelphia and specimens are also in the Michener collection at Washington. The main fructification measures 3.5 by 1.3 cm., and is seated on a slab of decorticated hardwood, said by Schweinitz to be *Vitis* (Pl. 24, fig. 5). The subiculum is a thin brown membrane on which are seated tubes 1 to 2 mm. long and surrounded by a narrow brown rather conspicuous velutinate margin. The hymenium is close to Dresden brown with finely velutinate surface, while the pores are angular to sinuous and average 1 to 2 per millimeter. The hymenium is in excellent fruiting condition with abundant spores both free and on basidia that are short-cylindric, hyaline, and measure 5 to 6 by 2 μ (text fig. 27). Setae are abundant and taper to a long lance-like point, projecting 30 to 45 μ beyond the basidia (Pl. 24, figs. 6, 7).



FIGS. 27–28. 27. Spores from the type of *Poria viticola;* 28. Hypha from the type of *P. viticola.*

Murrill has given a very good description of this species (N. Am. Flora 9: 4. 1908), except that the spore record is erroneous, and I measure the setae as somewhat larger than 6 to 7 μ diameter. It is by no means confined to *Vitis,* but grows on a great variety of dicotyledonous hosts.

The species grades over into *Trametes tenuis* Karst., a plant widely distributed in the United States and usually found in resupinate condition, but sometimes pileate. I hardly see how it will be possible to keep these two species separate. *T. tenuis* includes longer-tubed and narrower-pored forms than typical *P. viticola,* yet I have one collection from a coniferous host in Colorado that has some specimens that agree exactly with a large-pored

Missouri collection on *Vitis,* while other specimens show longer and narrower tubes characteristic of *T. tenuis.* Professor Romell, of Sweden, also sends me both of these forms under one herbarium name. *T. setosus* Weir is a somewhat intermediate condition between the two, though referable, if there is a specific distinction here, to *T. tenuis.*

While both *P. contigua* Pers. and *P. superficialis* Schw. are in all probability this species and both antedate the name *P. viticola,* yet the absence of spores in the type collections of both plants renders a definite conclusion impossible, and I shall retain the latter name to designate, for the present, our common large-pored brown *Poria* as here described and illustrated (Pl. 24, figs. 5, 8), without the inclusion of the typical *T. tenuis* form, though I find nothing more than arbitrary separation of collections possible. It is a common species, but I have never found typical examples of it on coniferous wood, while both *T. tenuis* and *Poria ferruginosa* are often so found. The last-named species is a close relative, but differs in the long ellipsoid spores and the somewhat different setae, as already described in this series of papers.

The following description is drawn from a wide range of specimens in the writer's herbarium.

Redescription: Annual or persistent, often broadly and irregularly effused but frequently in narrow elongated patches, inseparable, at first with a very narrow tawny pubescent or strigose-pubescent margin that usually persists though becoming more cinnamon in color and more glabrate with age; subiculum very thin, bright rusty brown; tubes unstratified though sometimes persistent, 1–2 mm. long, gray within, the mouths tawny olive to ochraceous tawny at first, finally of a duller color close to snuff brown or with a tinge of buffy brown, angular to somewhat sinuous, rather thin-walled but nearly entire, at first distinctly velutinate with rather coarse hairs, finally more glabrous, averaging 1–3 per millimeter; spores short-cylindric when mature, smooth, hyaline, 6–7 x 2–2.5 μ; setae abundant, visible in the tube walls under a good lens, projecting 25–45 μ, tapering to a long slender point, 7–12 μ diameter; hyphae straight, brown, no cross-walls or clamps, diameter 2–3 μ.

On bark and wood of deciduous trees of *Acer, Hamamelis, Populus, Quercus, Salix, Vitis,* and probably other hosts.

Specimens Examined: Lake Winnepesaukee, N. H.; Central Village, Conn.; North Spencer and Catskill Mts., N. Y.; Lakehurst, N. J.; Westport, State College, and Stone Valley, Pa.; New Richmond, Mich.; Meramec Highlands and Crêve Coeur Lake, Mo.

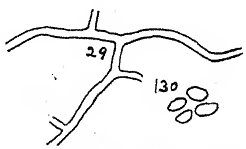
PORIA XANTHOLOMA (Schw.) Cooke, Grevillea **14**: 113. 1886

Polyporus xantholoma Schw. Trans. Am. Phil. Soc. II. **4**: 158. 1832.

Original Description: P. effiguratim effusus, tenuissimus, margine membranaceo fimbriato, latiusculo, sterili, eleganter luteo. Poris superficialibus, parietibus crassiusculis, subsinuosis, minutis, pallidis. Plagas 1–2 unc. irregulares efformat, ligni inaequabilitatem forma sequens.

Rarior occurit Salem ad ligna putrida.

Notes: Specimens of this species are preserved at Philadelphia and at Washington. The former is on a small piece of some large-pored wood like chestnut or oak and the fungus is a thin, hard species of a sordid yellow color close to pinkish buff or light buff. The tubes are not more than one half a millimeter long, the



FIGS. 29–30. 29. Hyphae of *P. xantholoma,* showing branching; 30. Spores of the same.

mouths rounded, averaging about 4 per millimeter and with entire dissepiments (Pl. 24, fig. 9). The spores are ellipsoid to ovoid or oblong-ellipsoid, hyaline, thin-walled, 5 to 6 by 4 μ (text fig. 30). An occasional fusiform sterile organ is present in the hymenium and measures 5 to 6 μ diameter. The basidia are large, 7 to 9 μ diameter. The hyphae are rather rigid, much branched, with no cross-walls or clamps and a diameter of 1.5 to 3.5 μ (text fig. 29). I was unable to secure sections good enough for photographing.

All of the characters are typical of the bright-colored form of *P. medulla-panis,* to which there is no question this plant should be referred.

PENNSYLVANIA STATE COLLEGE, STATE COLLEGE, PA.

EXPLANATION OF PLATES 21–24

PLATE 21

Fig. 1. Photograph, × 1½, of the type specimen of *P. candidissima*.

Fig. 2. Photograph, × 1½, of *P. candidissima* as represented by no. 4581, Overholts Herb.

Fig. 3. Photo, by 1½, of *P. candidissima* as represented by no. 4609, Overholts Herb.

Fig. 4. Micro-photograph, × 320, of a portion of the hymenium of *P. candidissima* as represented in Overholts Herb. no. 5972.

Fig. 5. Micro-photograph, × 160, of the cross section of the hymenium of *P. candidissima,* Overholts Herb. 5972.

Fig. 6. Photo, by 1½, of one portion of the type specimen of *P. caryae*.

PLATE 22

Fig. 1. Photo, × 1½, of a second portion of the type specimen of *P. caryae*.

Fig. 2. Micro-photograph, × 320, of a small portion of the hymenium of the type specimen of *P. caryae*.

Fig. 3. Micro-photograph, × 160, of a cross section of the hymenium of the type specimen of *P. caryae*.

Fig. 4. Micro-photograph, × 320, of a vertical section through a single tube of the type specimen of *P. decolorans,* showing a single projecting incrusted cystidium, and in the trama other cystidia seen in section.

Fig. 5. Photo, × 1, of the hymenium of a resupinate specimen of *Trametes sepium* for purposes of comparison with Fig. 6.

Fig. 6. Photo, × 1, of the type specimen of *P. favescens*. Compare with Fig. 5.

Fig. 7. Micro-photograph, × 320, of a small portion of the hymenium from the type specimen of *P. favescens*.

Fig. 8. Photo, × 1½, of the type specimen of *P. rhododendri*.

PLATE 23

Fig. 1. Micro-photograph, × 320, of cross section of single tube of type specimen of *P. juglandina,* showing single seta.

Fig. 2. Photo, × 1½, of type specimen of *P. nigropurpurea*.

Fig. 3. Micro-photograph, × 160, of cross section of hymenium of type specimen of *P. nigropurpurea*.

Fig. 4. Micro-photograph, × 320, of cross section of hymenium of type specimen of *P. nigropurpurea*.

Fig. 5. Photo, × 1½, of the type specimen of *P. papyracea*.

Fig. 6. Micro-photograph, × 320, of the major portion of a vertical section of a single tube of the type specimen of *P. papyracea,* showing the position of the peculiar spores along the hymenium.

Fig. 7. Photo, × 1, of one portion of the type specimen of *P. pulchella*.

Fig. 8. Micro-photograph, × 160, of cross section of the hymenium of the type specimen of *P. pulchella*.

Fig. 9. Micro-photograph, × 320, of cross section.

PLATE 24

Fig. 1. Photo, × 1½, of portion of the type specimen of *P. sassafras*.

Fig. 2. Photo, × 1½, of the type specimen of *P. superficialis*.

Fig. 3. Micro-photograph, × 320, of a small portion of the hymenium of *P. superficialis*, showing setae.

Fig. 4. Photo, × 1, of the type specimen of *P. tenuis*.

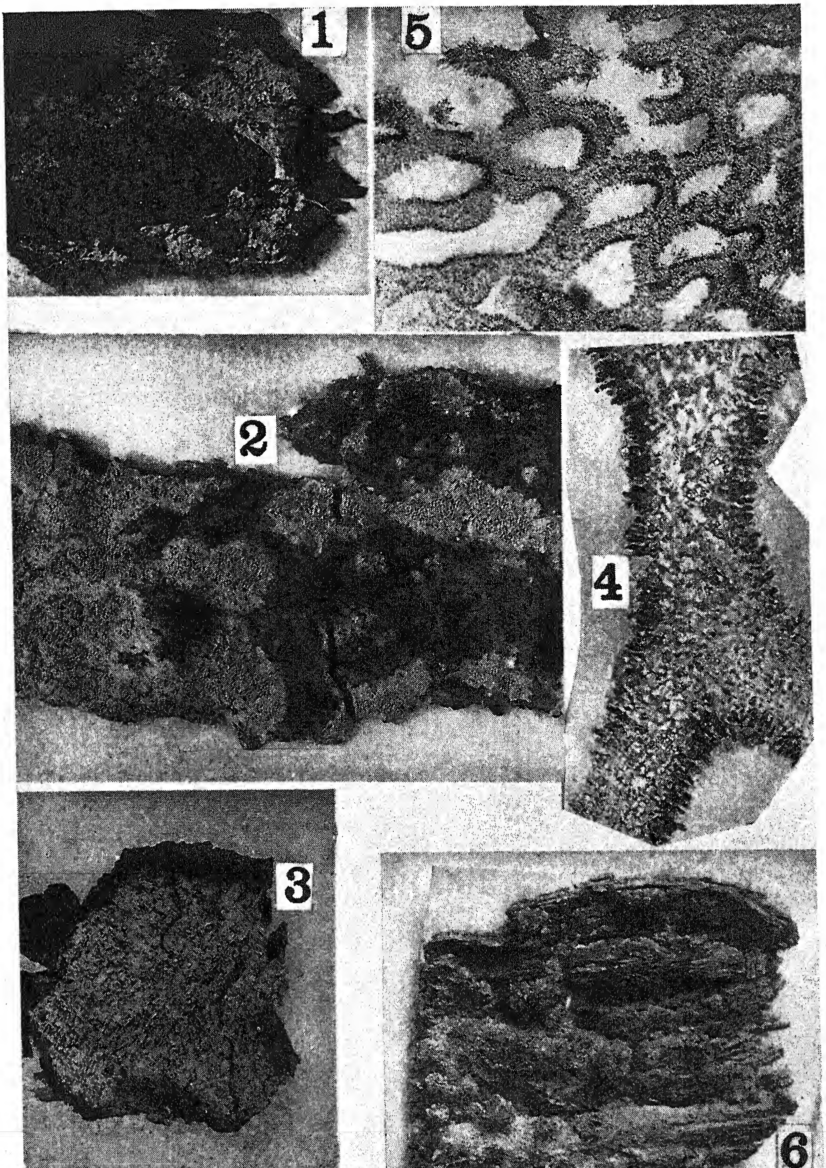
Fig. 5. Photo, × 1, of the type specimen of *P. viticola*.

Fig. 6. Micro-photograph, × 320, of a small portion of a single tube of the type specimen of *P. viticola*.

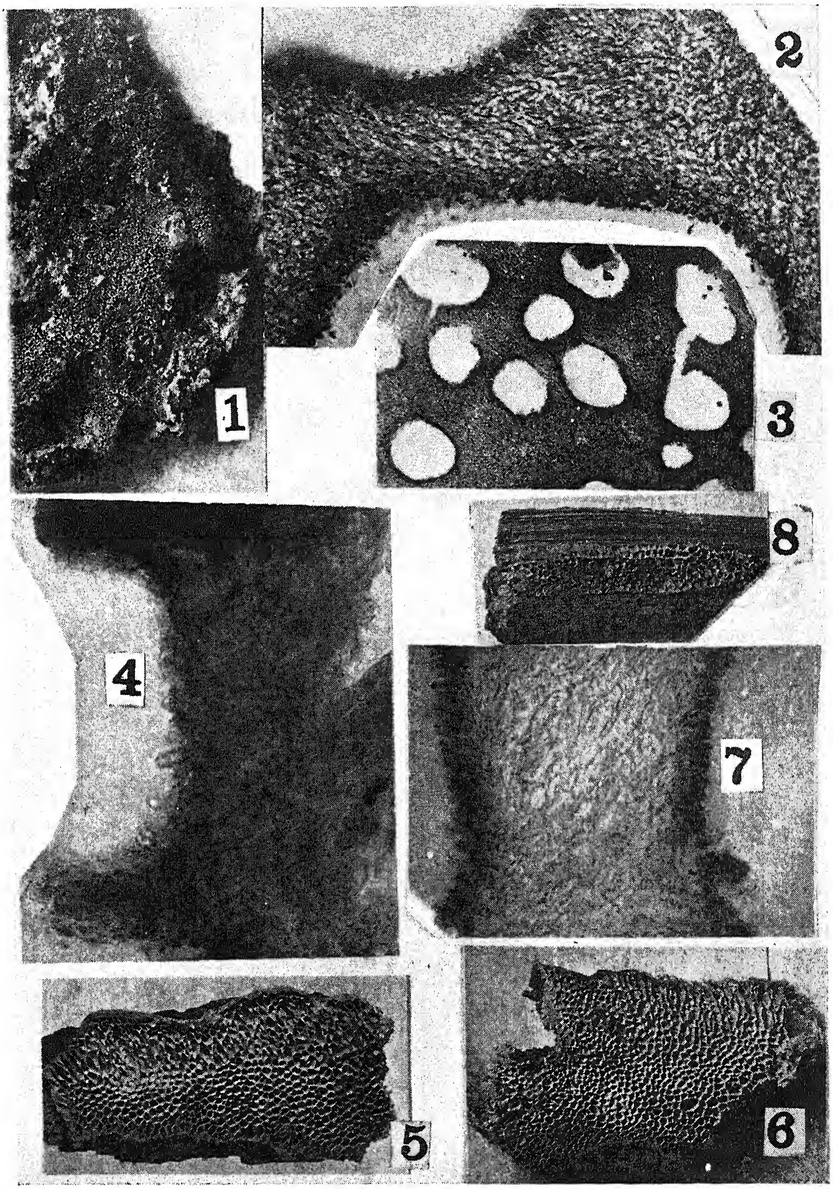
Fig. 7. Same, as seen under magnification of 160 diameters.

Fig. 8. Specimen of *P. viticola* on *Vitis*, as seen in specimen in Overholts Herb. no. 7530.

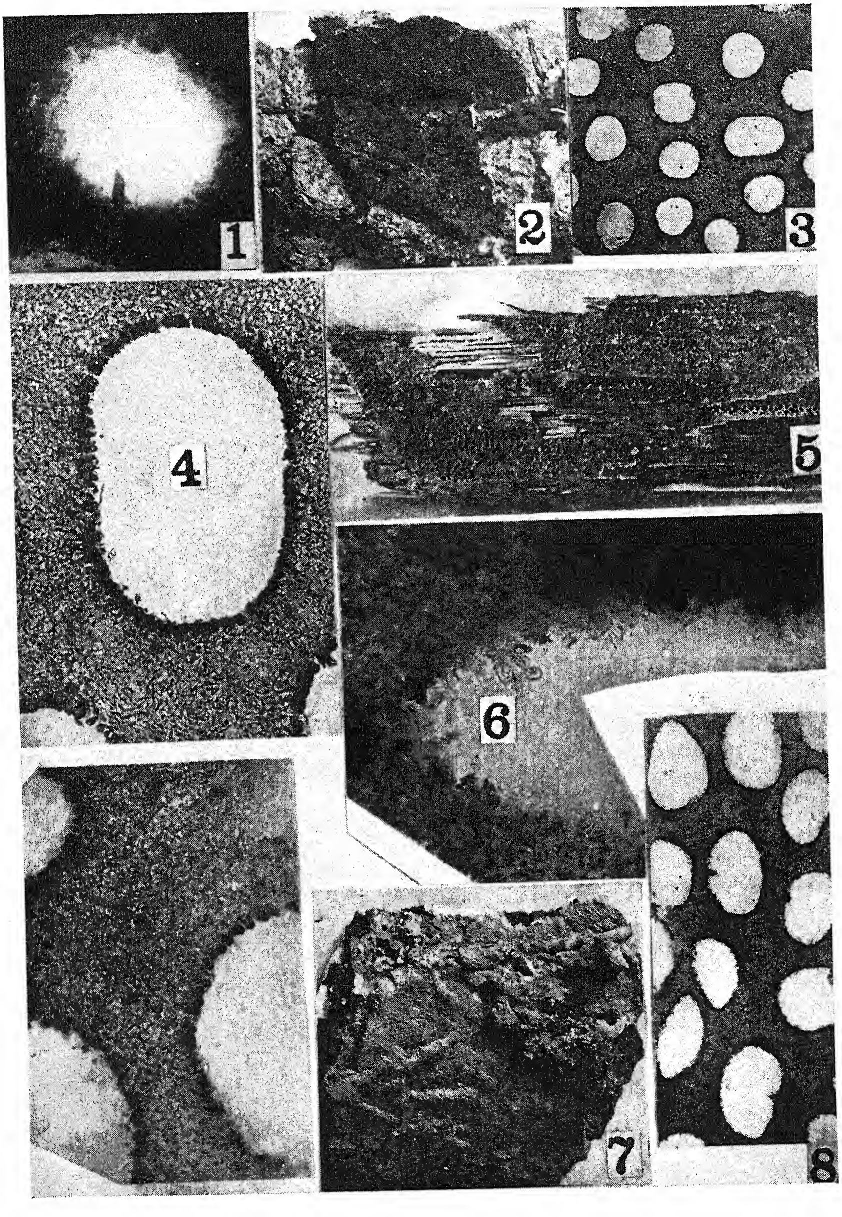
Fig. 9. Photo, × 1½, of the type specimen of *P. xantholoma*.



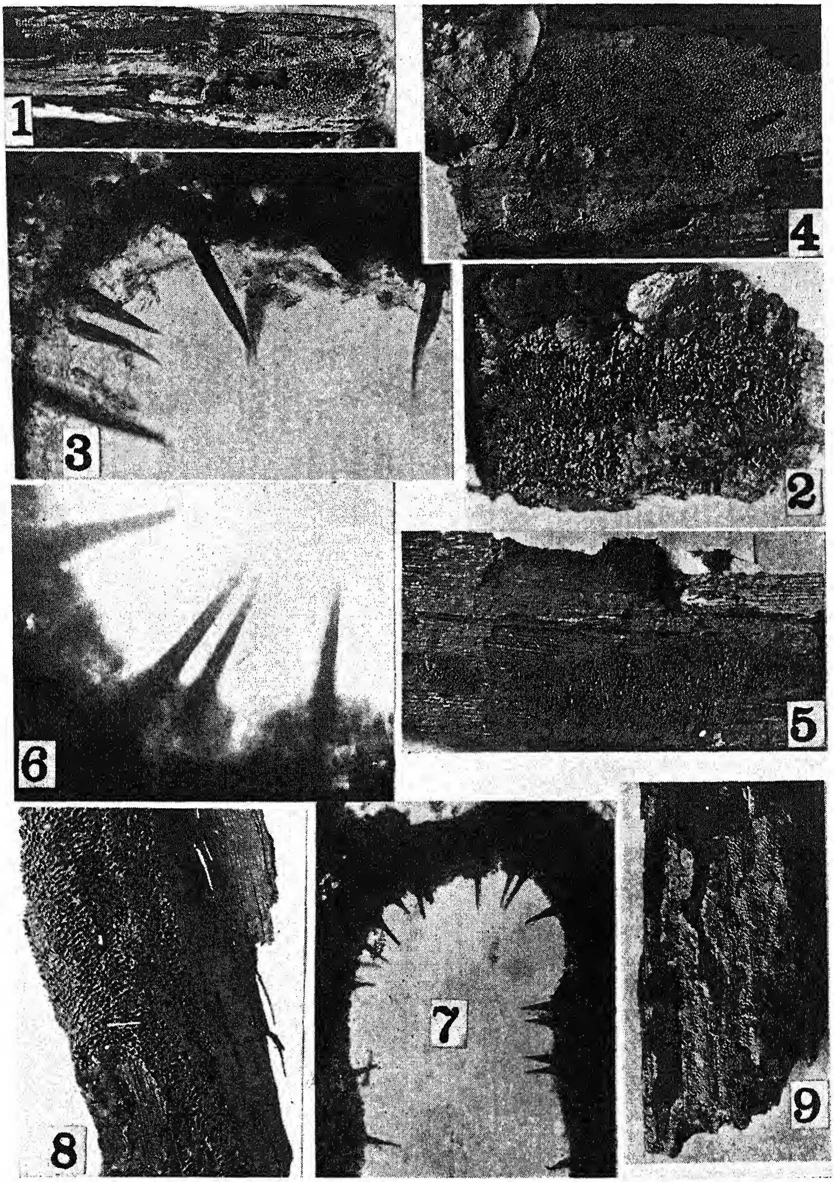
1–5. PORIA CANDIDISSIMA
6. PORIA CARYAE



1–3. PORIA CARYAE
4. PORIA DECOLORANS
5. TRAMETES SEPIUM
6–7. PORIA FAVESCENS
8. PORIA RHODODENDRI



1. Poria juglandina
2–4. Poria nigropurpurea
5–6. Poria papyracea
7–9. Poria pulchella



1. PORIA SASSAFRAS
2–3. PORIA SUPERFICIALIS
4. PORIA TENUIS
5–8. PORIA VITICOLA
9. PORIA XANTHOLOMA

THE LIFE HISTORY OF NECTRIA IPOMOEA

Melville T. Cook

(With Plate 25)

This species was first described by the late Dr. Byron D. Halsted, who believed it to be the cause of one of the numerous sweet potato rots. For many years this idea was undisputed, but was finally disproved by Harter and others. The prevailing idea at present is that the fungus is a saprophyte working on a decay which is caused by some organism preceding it. However, it is possible that it may be the cause of slight decay under certain conditions. It is found most commonly on black-rot sweet potatoes, a decay caused by *Sphaeronema fimbriatum* (E. & H.) Sacc. It grows luxuriantly on Cook's No. II medium, producing first a very abundant growth of hyphae, followed by great numbers of perithecia. This study was undertaken to determine the life history of this organism and also in hopes that it might be possible to locate the sexual organs. The medium was used both with and without agar, and the organism was grown in petri dishes, in test tubes, and in hanging drop cultures. The early stages were studied in hanging drop cultures and fragments from petri dish and test-tube cultures.

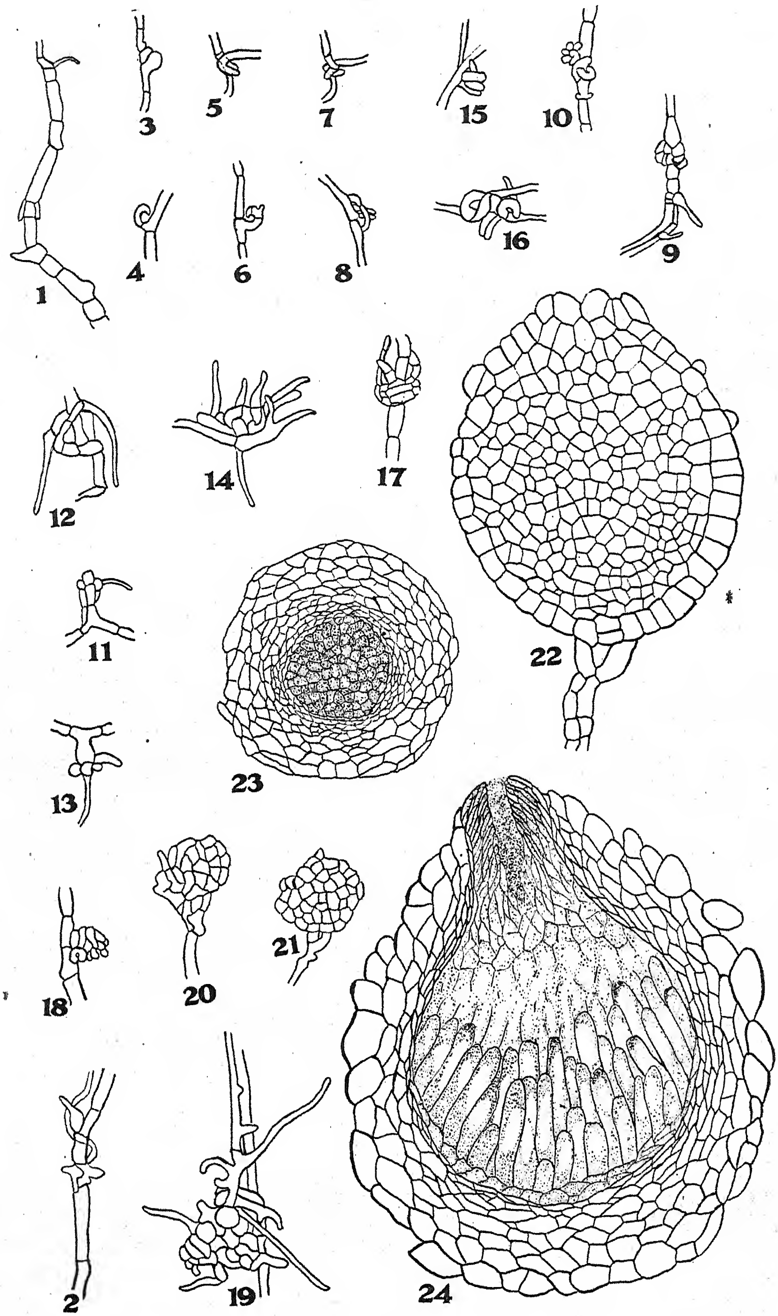
In the early growth of the fungus the hypha branches luxuriantly, but does not produce septa until considerably later in its development. The formation of the septa and later of the perithecia appears to be stimulated by the diminution of the food supply. The characteristic conidiospores are produced in abundance and well in advance of the formation of the perithecia. They are one- to six-celled, falcate, and extremely variable in size. There appears to be no definite order for the formation of the perithecia. They may originate from one or more than one hypha and in many cases show striking resemblances to the early stages of the Erysiphaceae and Aspergillaceae, but no union of cells or nuclei was observed (figs. 1–19). The variation in these

early stages could not possibly be greater. It is practically impossible to find any two that are the same. The massing and tangling of these hyphae is followed by increased growth and by the formation of numerous septa until we have a more or less globular structure which bears a superficial resemblance to the perithecia of the Erysiphaceae without the appendages (figs. 20–21). Cayley[1] also notes this "tangle of coiled hyphae" in *Nectria galligena,* but also failed to recognize an archicarp giving rise to a perithecium. So far as the writer was able to determine, all of these tangled masses of hyphae develop into perithecia, but Cayley states that in *N. galligena* some of them are sterile.

Microtome sections were necessary for a further study of these bodies. At first they were composed of a more or less homogeneous mass of cells throughout, but finally underwent a differentiation resulting in a central mass of thin-walled cells which are very rich in protoplasm and which are followed by several layers of small cells (fig. 23). Cayley claims to have been able to recognize ascogonia in this central mass of thin-walled cells, but the writer was unable to make any such distinction. The rostrum arises from one side of this globular mass and is apparently developed from this central mass of thin-walled cells and pushes its way through the two zones of cells just referred to (fig. 24). The side from which it arises will hereafter be referred to as the upper side and the opposite side as the basal side. The basal side lies next to the substratum. The asci arise from the basal side of the central mass of thin-walled cells—that is, directly opposite the rostrum. The writer was unable to determine their exact origin, but their growth is quite rapid. The mass of thin-walled cells above them gives way and apparently supplies them with food. The asci grow rapidly until the upper ends reach the lower part of the rostrum. The ascospores are mature and escape through the rostrum. Cayley does not describe the rostrum in *N. galligena,* but states that the "ascospores emerge through the raised ostiolum at the apex of the perithecium."

The life history of this species is very similar to that of *Nectria galligena* as described by Cayley, except that the writer failed to

[1] Cayley, Dorothy M., Some Observations on the Life History of *Nectria galligena* Bres., Annals of Botany **35**: 79–92 (1921).



NECTRIA IPOMOEA

recognize any ascogenous hypha such as has been described by Cayley.

This study was made in the New York Botanical Garden and the author expresses his thanks for the excellent facilities and coöperation.

EXPLANATION OF PLATE 25

Figs. 1–19. Early stages in the formation of the perithecia.

Figs. 20–22. Later stages in the development of the perithecia.

Fig. 23. Section of a perithecium, showing two zones of cells forming the wall and a central mass of parenchyma cells.

Fig. 24. Section of a perithecium approaching maturity, showing the formation of the rostrum and asci and the disintegration of the parenchyma cells before the advancing asci.

THE TRUFFLE INDUSTRY OF ITALY

C. G. Lloyd

Many people, particularly Americans and English, have a wrong idea of truffles. They seem to think that they are a kind of underground tuber that are eaten by the French as we eat potatoes. That is far from the truth.

Truffles are underground fungi, hypogaeal fungi as they are called, that are very fragrant and of good flavor, but of relatively rare occurrence and hard to find, and always bring a high price in the market. They are used as a flavoring for meat gravies, and are highly prized by the wealthy French and Italian gourmands for that purpose. Their high price precludes their use by the ordinary French or Italian people.

The black truffle, in normal conditions before the war, was sold in Paris from ten to twenty francs per kilo—that is, from one to two dollars per pound. The white truffle, which is more esteemed in Italy, is now sold from one hundred to four hundred lires per kilo, according to the season—that is, in our money at current rates, from five to twenty dollars a pound. At these prices it is needless to say that truffles are not used as food, but as a flavoring. The white truffle (*Tuber magnatum*) is particularly esteemed in Italy. It does not occur in France and only the black truffle is ordinarily sold in the French markets. In Italy the black truffle is not so popular and sells from five to ten lires a kilo—about twenty-five cents to one dollar a pound at present rates of exchange. The black truffle really consists of four species of *Tuber* (*Tuber aestivum, T. brumale, T. melanosporum,* and *T. macrosporum*), but they are not distinguished in the trade, and I was told by a truffle dealer, who has been engaged in the truffle trade for years, that there is but one kind of black truffle.

Truffles grow only in calcareous soil, and only in relation to the roots of certain trees, chiefly the oak, and buried and attached to the rootlets of the trees at a depth of two to six inches. Their

relation to the rootlets of the trees is not that of a parasite, but rather a friendly association.

In southern France, in the neighborhood of Carpentras, which is the center of the French truffle trade, there are large farms which are employed only to grow truffles; in Italy, however, there is no such industry. Italian truffles are collected only in the copses or wild, wooded parts of the foothills of the Alps, where they grow naturally. It is the country people who have truffle dogs. They hunt for them and collect them in the season and sell them to the merchants of villages, who market truffles the same as our country merchants market eggs.

Truffles develop during the summer and mature in the fall. They find the white truffle beginning in September and the black truffle about a month later and continuing into December. However, October is the principal truffle month.

The foothills of the Alps in Italy are one large vineyard, and as truffles will not grow except in uncultivated ground, nor in the vast plains of Italy, the places where they are found are relatively very restricted. It was fortunate that I learned from a reliable source the information from which I have extracted the foregoing. I have for years been in correspondence with Prof. O. Mattirolo, of Turin, Italy, who has made a special study for forty years of the classification of hypogaeal fungi, as truffles and other underground fungi are known. There are many kinds of hypogaeal fungi that are not truffles and are not used in commerce. Most species are too rare, or too small, or do not have the flavor, while some are even poisonous.

He may not realize it, for he is a very modest man, but Professor Mattirolo is the only one who has a thorough knowledge of their classification—the only man on earth who has studied them and collected them and worked with them for so many years that he has become the one authority on the subject. It was that fact that brought me to Turin, and Professor Mattirolo was most kind to me. He planned a trip for me to the section about sixty miles from Turin where truffles grow. He arranged with a truffle hunter to bring his dogs and demonstrate the manner in which they are collected. First, we went by rail about forty miles to Casale, where we were the hosts of Dr. Luigi Gabotto, who is director of

the Pathological Institute at Casale and a man of considerable business interests. He has a large place near the town (which we visited) where he grows grapevines by the thousand grafted on American wild stock to resist Phylloxera, an insect that has destroyed many vineyards in that region. He placed an automobile at our disposal and accompanied us about twenty miles distant to Crea, which is a religious reservation of many acres on one of the foothills of the Alps. There we met by appointment Enrico Lanfrancone and his father, Pietro Lanfrancone, with his two truffle dogs. The young man is a truffle dealer at Moncalvo, the center of the truffle trade of this region. He is said to have made a fortune in the business. His father is now the owner of a café at Moncalvo, but he is an old truffle hunter and has hunted in the region for years.

As truffles grow beneath the ground and give no surface indication, they would be found only by the merest chance were it not for the aid of dogs. These dogs are most intelligent animals, trained especially to hunt truffles. It is not natural for a dog to hunt truffles as they hunt for rabbits in our country. There are men who make a business of training truffle dogs and I am told that a good dog commands a high price, sometimes as much as one hundred dollars.

Under the direction of the master's voice—and the dog seems to understand every word his master speaks—he smells the surface of the ground very closely. When he scents a truffle he scratches the dirt away to a depth of four or five inches. The master watches the operation and picks up the truffle when it is thrown out with the dirt and rewards the dog with a small piece of bread for every truffle found. Our visit was not made during the truffle season and all we found was a few small specimens not larger than hazelnuts, but it was most astonishing to me to note how the dog seemed to understand just what was expected of him. It was wonderful how he could detect by its odor a small truffle, perhaps not larger than a pea, buried to a depth of five or six inches.

In conclusion, I wish to acknowledge my indebtedness to the gentlemen previously mentioned, and particularly to the old truffle hunter, Signor Pietro Lanfrancone, and his most intelligent dogs.

TURIN, ITALY.

NOTES AND BRIEF ARTICLES

(Unsigned notes are by the editor)

Dr. N. Patouillard, of Paris, writes me that he has left the drug business and taken Hariot's place at the Museum. His present address is 32 Avenue de Neuilly.

An excellent description of potato diseases in compact form, prepared by G. R. Bisby, was published in March, 1923, as Extension Bulletin 66 of the Manitoba Agricultural College.

Sclerotinia carunculoides, the cause of a serious disease of the fruit of *Morus alba* in South Carolina, is described as new by E. A. Siegler and Anna Jenkins in the *Journal of Agricultural Research* for March 10, 1923.

A bacterial disease of foxtail, caused by *Pseudomonas alboprecipitans* Rosen, is discussed in great detail by H. R. Rosen in the *Annals of the Missouri Botanical Garden* for November, 1922. This splendid paper is an excellent introduction to the bacterial diseases of grasses.

A specimen of *Daedalea quercina* found on willow was sent me by Mr. G. W. Martin, of Rutgers College, on May 14. Two hymenophores were collected in April at Mt. Bethel, New Jersey, growing on exposed heartwood of living *Salix alba vitellina.*

An old English book containing notes on plants found in North Wales, includes the following caution regarding fungi:

> "Let my advice perswade thy mynde
> not to truste any of that kynde,
> such as be taken for the beaste (best)
> doe prove as poisnusse as the reste."

Young chestnut trees in California have recently been attacked by a species of *Fusicoccum,* which produces a disease similar to that caused by the chestnut canker in the eastern United States.

For an account of the symptoms, distribution, and treatment, see a paper by C. E. Scott in Monthly Bull. Dept. Agr. Cal. **11**: 740. 1922.

Decays and discolorations in airplane woods are discussed in a comprehensive way by J. S. Boyce in Bulletin 1128 of the U. S. Dept. of Agriculture, dated February, 1923. The 43 pages of text are accompanied by 7 handsome colored plates.

"Trees as Good Citizens" has been most generously distributed by its author, Mr. Charles Lathrop Pack. Chapter 18 is devoted to the fungous diseases of trees and their treatment.

A preliminary list of Manitoba fungi prepared by G. R. Bisby and A. H. R. Buller appeared in the *Transactions of the British Mycological Society* for December 14, 1922. The list contains 574 species, of which 80 are rusts, 63 polypores, and 108 agarics.

The biology of *Schizophyllum commune,* with special reference to its parasitism, has been investigated by V. A. Putterill (Dept. Agr. Union S. Africa, Sci. Bull. 25, 1922), who finds this fungus able to grow on the living wood of various fruit trees, feeding upon the cellulose and doing considerable damage.

A new disease of ferns, caused by *Alternaria polypodii,* was described by T. G. Major in the annual report of the Quebec Society for the Protection of Plants for 1921–1922. The host (*Polypodium* sp.) was growing in the experimental greenhouse at Macdonald College, and the fungus caused brown, concentrically zoned spots on the fronds and stems.

Four very important papers on the Species Concept read at the Toronto Meeting were published in the *American Journal of Botany* for May, 1923. George H. Shull discusses the subject as a geneticist; R. A. Harper as a morphologist; Guilford Reed as a physiologist and bacteriologist; and E. C. Stakman as a plant pathologist.

An article on the mycological flora of the higher Rockies of Colorado, by C. H. Kauffman, has just reached me as a reprint from the first volume of the *Papers of the Michigan Academy of Science*. This important paper deals with all groups of fungi and includes descriptions of the following new species: *Helotium alnicola, Boletus tomentosus, Cortinarius bistreoides, C. citrinellus, C. glaucopoides, C. griseoluridus, C. metarius, C. nigrocuspidatus, C. pinetorum, Marasmius piceina, M. pinastris,* and *Pholiota platyphylla.*

In the report of the New York State Botanist for 1921, issued May 15, 1923, Dr. House lists 42 species of fungi new to the state, several of which are described as new in this report. A paper by Dearness & House includes the following new species: *Gloeosporium polygoni, Gnomonia papillostoma, Haplosporella dulcamara, Microdiplodia spiraeocola, Mycosphaerella oxycocci, Septoria pallidula, Spegazzinea rubra,* and *Sphaerulina acori.* Notes on a number of miscellaneous fungous collections are largely based on determinations by Dr. E. A. Burt and Dr. J. C. Arthur.

Forest pathology in relation to forest conservation was discussed by J. H. Faull in the annual report of the Quebec Society for the Protection of Plants for 1921–1922. The cause of white pine needle blight appears to lie in the absorbing roots, which are dead in blighted trees. The fungus, *Fomes fomentarius,* causing heart-rot of birch and beech enters living trees through wounds and dead stubs, and penetrates rapidly both sapwood and heartwood. According to the author, "Timber cured while the decay is in its incipient stages is indistinguishable from sound timber. Infection of birch appears to be associated with the action of an insect boring at the crown."

The literature on the classification of the Hysteriales has been brought together by G. R. Bisby in the *Transactions of the British Mycological Society* for March 21, 1923. About 700 species in 46 genera have been described. According to the author, "The members of the Hysteriales were at first confused with lichens,

certain of which they resemble. Early workers inevitably drew up vague descriptions of these fungi. The name of the group is based on the genus *Hysterium,* which was first used by Tode. The type species is *H. pulicare,* the name of which can be traced back to Lightfoot. Persoon succeeded in bringing a number of similar forms together, largely by an inclusive interpretation of the genus *Hysterium.* Chevallier first used the name 'Hysterineae' for an order, and he also separated into another order certain genera now included in the Phacidiales. This work has been generally overlooked in considering the beginning of a separate grouping on these fungi. Corda used the family name Hysteriaceae to include also the Phacidiales; most other workers, down to the middle of the 19th century, including Fries, placed the genera now classified in the Hysteriales with the Phacidiales. The genera came finally to be distinguished principally on the basis of the colour, shape, and septation of spores."

PROFESSOR HOLWAY

The death of Professor E. W. D. Holway, of the University of Minnesota, occurred March 31, at Phoenix, Arizona. Professor Holway returned in October from a year's collecting of fungi and flowering plants in South America with a slight indisposition, which was later diagnosed as influenza. Shortly after returning severe complications appeared, from which he sufficiently recovered early in March to make the trip to Arizona. His full recovery seemed to be assured, when his sudden and unexpected demise from heart failure occurred. He was seventy years of age.

For many years Professor Holway was a banker at Decorah, Iowa. His avocation was collecting. In his youth it was coins, then insects and various natural history objects. Along with these he secured books dealing with the different specialties, and took particular delight in early and rare volumes. During the 'seventies he turned to the collection of flowering plants, and in the 'eighties took up fungi. Eventually the plant rusts engaged the chief part of his attention.

Professor Holway had remarkable ability as a collector. He

not only obtained a great amount of material, but prepared it for the herbarium with unusual skill and neatness. It is to his indefatigable labors that the rust flora of northern California and the Selkirks, central Mexico, Guatemala, and Costa Rica have become well known. The extensive collections which he made in South America—Chile, Peru, Bolivia, and Ecuador in 1919–1920, and southern Brazil, Uruguay, and northern Argentina in 1921–1922—have not yet been sufficiently studied for publication.

J. C. ARTHUR

VIRGINIA FUNGI

During a visit to southwestern Virginia, July 10–20, 1923, a number of fungi were picked up at Mountain Lake (4,000 to 5,000 feet elevation) and Blacksburg (2,200 feet elevation). The season was, of course, more advanced at the lower elevation.

The most abundant fleshy species at Mountain Lake was *Russula foetens,* with *R. furcata* and a pretty red species fairly common and *R. delica* appearing only once. *Lactaria subdulcis* and *L. lactiflua* were just beginning to appear. *Collybia platyphylla* was found several times; *C. dryophila* twice; and *C. maculata,* a bitter species, once. *Omphalia campanella* was already well advanced and well distributed and a little white species of *Marasmius* was seen by the thousands on dead leaves and sticks, while *Mycena galericulata* had just begun to develop.

The only Amanita seen on the mountain was *A. Frostiana,* which was quite common in spots under the rhododendrons about the lake; and the only Amanitopsis was *A. vaginata,* represented by a few young hymenophores. *Chanterel cinnabarinus,* a bright-red species, was seen twice on the walk to Prospect Rock and *Hygrophorus psittacinus* once. I also made single collections of *Lepiota cristata, Paxillus involutus,* and *Hypholoma fasciculare;* the last, an intensely bitter species, appearing on roots in the road to Bald Knob.

The fairy-ring mushroom, *Marasmius oreades,* was beginning to develop in the lawns about the hotel; where *Pholiota praecox,* another edible species, was found twice. *Panaeolus campanulatus* and *Stropharia semiglobata* were the only dung-loving species

noticed. The oyster mushroom and a common species of Crepidotus were beginning to appear on dead deciduous wood, and I saw one group of the tiny "nests" of *Crucibulum vulgare.* A single puffball, *Lycoperdon gemmatum,* of this season was found; while the hard-skinned puffball, *Scleroderma aurantium,* was more advanced, being represented by a large group of mature sporophores. Two or three dozen old sporophores of *Geaster hygrometricus,* left over from last season, were noticed on the open ground where the bowling alley used to be, and one was found near the top of the mountain.

Of the boletes, only *Boletus communis* and *B. felleus* had made their appearance at this elevation, and these only in one or two specimens. *Laetiporus sulphureus* was found fully developed in large masses on a chestnut log near Prospect Rock, and *Coltricia splendens* grew in the path above the fossil bed. Near the hotel, the stems and fruits of a hawthorn tree were covered with the cluster-cup stage of a *Gymnosporangium,* and the hymenophores of *Fulvifomes Robiniae,* on black locust, were developing a new layer of tubes. *Elfvingia megaloma, Daldinia concentrica, Coriolus versicolor,* and several other woody and leathery species of wood-destroying fungi were seen on various kinds of decayed wood; while heart-rotting fungi like *Ganoderma Tsugae, Pyropolyporus ingiarius,* and *Elfvingiella fomentaria* appeared in considerable numbers as conspicuous brackets on the trunks of living hemlock, birch, and beech.

At Blacksburg, the first crop of fungi had matured, following copious rains. Many species were seen in Heath's Woods, Broce's Woods, and beyond Slusser's on the road to Dry Run, but I will not list these at present. A handsome specimen of *Cordyceps herculea,* not quite mature, was found in leaf-mold beneath a white oak growing from a buried insect; and a splendid cluster of *Pholiota Johnsoniana* was taken from the interior of a much decayed stump of some deciduous tree. This latter species, which was described and figured in MYCOLOGIA for September, 1915, is remarkable for its large white annulus and for its resemblance to certain species of *Stropharia.*

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MYCOLOGIA

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SOME OBSERVATIONS ON THE DEVELOPMENT OF ENDOGONE MALLEOLA HARK.

LEVA B. WALKER

(WITH PLATES 26 AND 27)

Species of *Endogone* are so rarely found in abundance that when, during September, 1921, a great quantity of *Endogone malleola* was found growing on soil and ground litter in a mixed deciduous woods near Lincoln, Nebraska, it seemed worth while to attempt some studies upon its development. It seemed especially desirable because there are no publications giving the details of development of any of the non-sexual species of *Endogone*, and it is the gross appearance of this type of *Endogone* that lead various workers to consider *Endogone* as an Ascomycete, sporangia having been mistaken for asci.

Specimens were sent to Dr. Roland Thaxter and to Dr. E. A. Burt for determinations. Both considered it to be what is known as *E. malleola* Hark. The reference of this form, and closely related forms, to *Endogone* is entirely provisional, as has been pointed out by Thaxter (8).

A large number of these fruits were fixed in Fleming's stronger solution and Gilson's fluid for future study, while others were used for germination and cultural studies. The fungus appeared again in September, 1922, and materials were fixed in Fleming's stronger solution and dilute chrom-acetic solution and others used for cultural work. The specimens collected in 1922 were not in as good condition as those of the 1921 collection, so little use was made of them in the morphological study.

[MYCOLOGIA for September (15: 197–244) appeared September 15, 1923]

DESCRIPTION OF SPORANGIOCARPS

The sporangiocarps are whitish, rounded, or somewhat elongated bodies, about 1–4 mm. across (pl. 26, fig. 4). The upper surface is hemispheric, smooth or more or less convoluted, while the under surface is slightly depressed except where delicate strands of hyphae attach it to the substratum. In sectional view (pl. 26, figs. 9, 10, 12–14) the interior is found to consist of a compactly interwoven portion at the base, made up of closely septate hyphae, which also show many anastomoses. From this, other septate hyphae extend radially toward the surface and give rise to an outer region in which are found intermingled hyphae and sporangia. The sporangia are many spored and look much like those of a mucor, but lack a columella, as is true of *Mortierella*. A great deal of variation from the type given in Harkness' (5) original description was observed, and Dr. Thaxter (8) (also in personal letters) says that similar variations have been noted by him in other collections. Two quite distinct types of sporangiocarps were found which might be designated as small and large sporangial types.

In the small sporangial type the fructifications are almost hemispheric (pl. 26, figs. 9, 12, 13) and the sporangia average about 30 μ in diameter, running up to about 45 μ as a maximum. The sporangia in this type are usually terminal, but seemingly may be intercalary,[1] and are densely massed together toward the outside of the fruit. Each sporangium contains relatively few spores (pl. 27, fig. 14), averaging 10–13 x 12–15 μ, but occasionally there are very small (5 x 6 μ) and very large (20 x 33 μ) spores. Mixed with the sporangia are hyphae, terminating in somewhat moniliform cells, and these, together with the stalks of some of the sporangia which reach the surface, give the appearance of a delicate cobwebby peridium (pl. 26, fig. 11).

[1] In materials treated with potash and teased apart long filaments bearing 2–3 sporangia at their tips are frequently found. In rolling these over and over so as to examine all surfaces no traces of sporangiophores or scars left by sporangiophores can be found, in some cases, except for the basal sporangium. On the other hand similar chains of sporangia were found where sporangiophores were attached to each sporangium. The same conditions were observed in serial sections of sporangiocarps.

In the second or large sporangial type (pl. 26, figs. 10 and 14) the fructifications are often much flatter and in the sporangial region few intermixed hyphae are found. No traces of moniliform cells or superficial hyphae occur. The sporangia (pl. 27, fig. 15) are definitely terminal, much larger (50–70 μ) in diameter, and contain many spores. The spores in these larger sporangia are slightly smaller (7–10 x 10–13 μ).

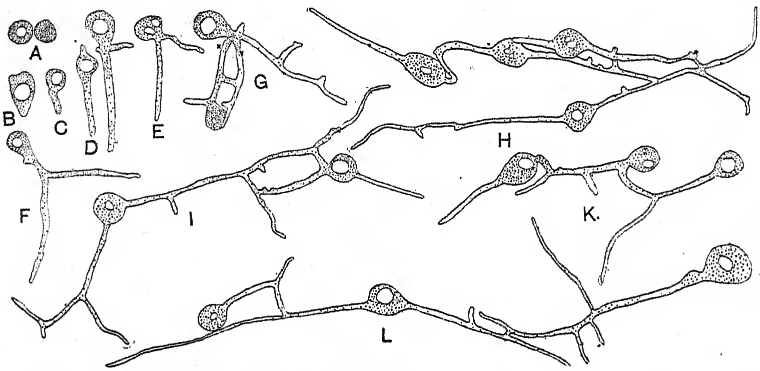

FIG. 1. Spore germination and anastomoses. × 300. *A*, Two spores; spore to right younger than spore to left. *B–G*, Spore germinations in soil extract hanging drop 18 hours old. *H–L*, Same cultures when 24 hours old.

The spores in earlier collections of both types were filled with a uniform, coarsely granular content (pl. 27, figs. 12 and 14), but later collections showed one or more large globules in each spore (pl. 27, fig. 15). Also see text fig. 1, *A*.

All collections made during 1921 showed both types ot fructifications, with the small sporangial type predominating. During September, 1922, only the large sporangial type was found. The climatic conditions during the two seasons were very different. During 1921 the fungus appeared following a long period of extremely hot, wet weather. During the latter part of the summer of 1922 exceptionally hot, dry conditions prevailed, so that little could develop. It appeared in about a week following a few rainy days and as no more rains came no continued development was possible. These climatic differences possibly account for the variations in the appearance of the fructifications.

Spore Germination, Protoplasmic Movements, and Cultures

The spores germinate readily in water, soil extract, or in any of the various agar agar media tried (text fig. 1). One to several germ tubes develop from each spore in 8 to 16 hours. The germ tubes grow rapidly and in 18 hours appear as shown in text fig. 1, *B–G*. Wherever two or more spores are in close proximity to each other anastomoses occur. As the tubes elongate, granules which densely filled the spores move out from the spores into the hyphae. The growth is so rapid that one may easily see a streaming movement of the granules by the time the tubes are ten times the length of the diameter of the spore and often before the tubes are this long. As the anastomoses occurred, the dissolution of the intervening walls could easily be determined by the movement of granules from one hypha into the other, as from *x–y* in text fig. 1, *G*. When spores were grown in water or soil extract, hanging drops many more anastomoses occurred than when grown in more highly nutrient media. Text fig. 1, *H–L,* and pl. 26, fig. 6, show anastomosing germ tubes as developed in a soil extract, hanging drop 24 hours old.

As more and more of these anastomoses occur, larger hyphae develop, into which the contents of many spores are emptied (text fig. 2, *M,* and pl. 26, figs. 7 and 8). After the protoplasm has all been emptied out from the spore into the larger or distributive hypha, cross-walls are usually formed cutting off the empty portions. In hanging-drop cultures a few days old these distributing hyphae are easily followed for a centimeter or more, even across the entire circle of the cover of the hanging drop. They usually extend in almost straight lines only here and there, branching or anastomosing with other large hyphae similarly developed (pl. 26, figs. 7 and 8). (Fig. 8 shows the detail of the anastomosing and branching occurring in the lower central portion of fig. 7.)

In these larger hyphae the protoplasmic movement was extremely conspicuous and far more rapid than is ordinarily seen in plant cells. So rapid was the movement that it seemed impossible to determine the rapidity accurately, but granules were easily carried 50 μ per second in many cases, while movements of granules up to 20 or 30 μ per second were often seen. The protoplasmic

movements attained their maximum rapidity in cultures about 4 days old and continued at nearly the same rate till the drop dried out, usually about ten days.

In a few cases hanging-drop cultures were made from immature sporangia, and while the spores were well developed in most of the sporangia, the sporangial walls retained the spores. In such cases hyphae developed from the base of the sporangium (text fig. 2, *N*). These hyphae had the same characteristics as the large hyphae which arose from the anastomosing of germ tubes coming from the spores. As many of the spores in the sporangia became empty, it seemed probable that the spores germinated and their tubes anastomosed within the sporangium.

In all cases where vigorous streaming occurred there was a main current running in one direction, but small reverse streams could be seen also, showing a definite cyclosis. These movements are indicated by arrows in text fig. 2.

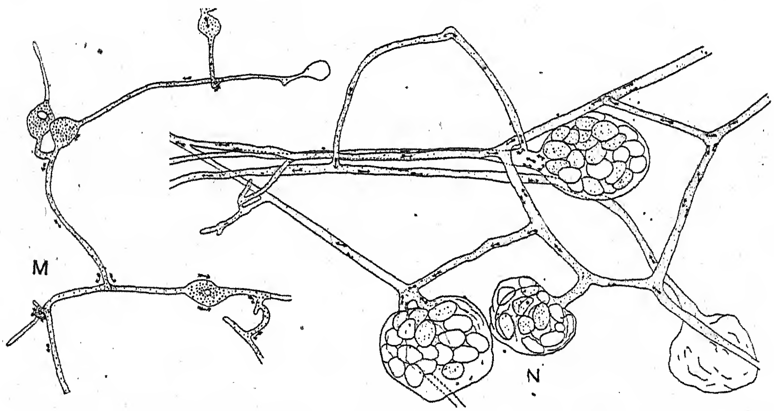

FIG. 2. Distributive hyphae and protoplasmic movements. *M*, an early stage in the formation of distributive hyphae. × 300. *N*, Distributive hyphae emerging from sporangia. × 250. Arrows indicate protoplasmic movements.

Germinating spores, fixed and stained upon the cover-glass, showed the spores and the hyphae coming from them to be multinucleate.

Since the spores germinate so readily, numerous attempts were made in 1921 to obtain the fungus in pure culture, but without success. All fruits examined in both fresh material and stained

sections showed an abundance of bacteria mingled in with the hyphae of the fruit body of the *Endogone*. A species of *Fusarium* was also abundant and in no case was it possible to separate the *Endogone* from the bacteria and *Fusarium*. In these, impure culture masses of moniliform cells appeared in a number of cases. They arose as lateral branches of distributive hyphae (text fig. 3, *O*) and soon increased in number so greatly as to form masses up to a millimeter in diameter and appearing superficially like mature sporangial fruit bodies. The branching and appearance of these moniliform cells is shown in text fig. 3, *P–S*. Text fig. 3, *T*, shows one of these masses about ½ mm. in diameter that developed in a hanging-drop culture. The mass was developed between the hyphae and the cover slip. During its development the protoplasmic streaming was very rapid from all sides toward the mass of moniliform cells, while the reverse movement was so slight that at times it was almost impossible to observe it. Similar masses appeared upon some agar cultures and were kept moist for months, but no further development resulted. Some of these masses appeared below the surface of the agar medium, while others were entirely superficial.

Because of the failure to get pure cultures and sporangial development in 1921 a second effort was made to obtain *Endogone* in pure culture in 1922. Because of the climatic conditions prevailing this last season all of the sporangiocarps were young and there had been little chance for infection. As the spores did not separate readily from the sporangia, no attempts were made to get one-spore cultures, but fragments from the interior of sporangiocarps planted upon agar media gave an abundance of mycelium, showing all of the characteristics of *Endogone* mycelium obtained from germinating spores the previous season. About 20 separate cultures were thus obtained. The appearance of such culture is shown in pl. 26, fig. 1. A number of these cultures have been grown upon corn-meal agar, corn-meal agar + dextrose, soil-extract agar, soil-extract agar + peptone, beef extract + glucose agar, sterile soil, sterile leaf cover, sterile soil and leaf cover + peptone, sterile soils and leaf cover + sodium nitrate, sterile soil and leaf cover + calcium nitrate, corn-meal mush, bean pods, sawdust,

etc. Vigorous development resulted on all except the last two. In most cases clumps of moniliform cells appeared in about a week to ten days (pl. 26, figs. 2 and 5), and in many cases these masses grew to a size and form indistinguishable to the naked eye from the sporangial fructifications, but no sporangia have ever developed. The clumps of moniliform cells occurred most abundantly on corn-meal mush, while the development on the various soil cultures appeared more nearly like sporangial fructifications.

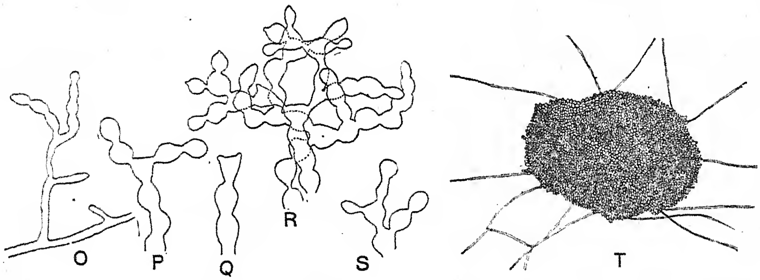

FIG. 3. Development of moniliform cells and masses. *O*, Origin of moniliform cells. *P–S*, Branching of moniliform hyphae. *T*, A mass of moniliform cells ½ mm. in diameter with hyphae from which it developed. *O–S* × 300; *T* × 50.

Various attempts were made to test the possible effect of heat, moisture, and light upon the development of these clumps of moniliform cells. Cultures were held at different temperatures, at fluctuating temperatures (cooler at night and warmer during day), were allowed to dry out and then watered, were kept in direct and diffuse light, etc., but no combination tried changed the development of these clumps.

The different cultures obtained showed considerable variation in vigor of growth and development of moniliform cells. Some strains grew rapidly and developed large masses of moniliform cells, while others grew very slowly and developed very few or no clumps of moniliform cells. Others showed so little vigor that they soon died. Various attempts were made while the cultures were fresh to contrast strains in the hope that this might stimulate further development, but obtained no results. Later a series of all possible crosses of nine strains that survived was made, but no further development resulted.

In sections the interior of these masses is found to be made up of interwoven and anastomosing hyphae resembling those on the on the outside closely resemble those found on the outside of some very young sporangial fructifications, as will be described later, but nothing resembling the radiating hyphae that are so prominent in the sporangiocarps are to be found. The masses as formed in cultures have a firm, solid consistency throughout, as would result from the dense interweaving of the moniliform branches. Cross-walls may be put in, in the older moniliform cells, but these cells never separate from each other to form spore-like bodies. Two possibilities in regard to these masses of moniliform cells suggest themselves to the writer. The one is that these are possibly sclerotia, as the cells become densely filled with oil globules, and the other, and more probable, is that they are aborted fructifications and that the proper stimulus for sporangial development is lacking under cultural conditions. That the fructifications have only been found in September also adds weight to this idea.[2]

DEVELOPMENT OF SPORANGIOCARPS

The youngest sporangiocarp found in sectioning the fixed materials was of the small sporangial type and is shown in pl. 26, fig. 17. On one side (pl. 26, fig. 17, right, and fig. 18) are moniliform cells and on the other (pl. 26, fig. 17, left, and fig. 16) are young sporangia with spores. In between these (pl. 26, fig. 17, top, and fig. 15) intermediate (possibly aborted) stages in the development of the sporangia are found. The first sporangia appear to arise directly from the enlargement of moniliform cells, but so little material in a very young condition was available that a positive statement can not be made. Often, as in this case, the sporangiocarps were in poor condition before fixation, as is indicated by a less dense protoplasmic content and by the presence of masses of bacteria in the spaces. The bacteria appear as dark masses be-

[2] The writer was absent from Lincoln from the middle of June until Sept. 1, 1922. A student in the department made repeated visits to the woods where it has been found but failed to find any. The possibility exists, however, that it might have been overlooked if present in very small amounts. During the summer of 1923 the writer made frequent visits to the woods where *Endogene* had been obtained previously, but found none until the middle of August, when one lone sporangiocarp was discovered. Cultures from this resulted as previously.

tween filaments and around sporangia in the photographs (figs. 15–18). The fixing agent (Gilson's) also caused much plasmolysis in the outer regions.

The examination of sections of many fructifications of the small sporangial types indicates that as the sporangiocarps grow older other sporangium-bearing hyphae grow up from below and intermingle with the sporangia that seem to be formed from moniliform cells. These have only terminal sporangia. The stalks often grow out beyond the other sporangia and backward so that the sporangium rests upon the surface of the fructification. These stalks are often so abundant as to give the appearance of a cobwebby peridium under a hand lens. Development in a sporangiocarp does not seem to be uniform. One side is commonly much younger than the other. Young sporangia are especially often found near one margin, but may be found in various positions on the fructification. This irregular continuation of growth probably gives rise to the convoluted appearance often observed. No relationship between age and size of sporangiocarps was observed.

It has been very difficult to form any idea as to stages in the development of the large sporangial types. Some fructifications were found that consisted of hardly more than a dozen very young sporangia. They seemed to consist of long-stalked sporangia, the sporangiophores radiating from a small weft of hyphae at the base. One of these fructifications is shown in pl. 26, fig. 3. Other fructifications no larger than this showed mature sporangia. The larger fructifications seem to be only larger masses of sporangia arising from larger wefts of mycelia. They possibly represent rapidly developed fructifications formed under optimum conditions.

DEVELOPMENT OF SPORANGIA

The development of the sporangia appeared to be the same in both types of fructifications. The young sporangia are densely filled with a multinucleate protoplasm (pl. 27, figs. 1–3). The protoplasm in a hypha, leading to a sporangium, forms a loose mesh work, and that in a sporangium a slightly closer mesh work. A cross-wall is soon put in which separates the sporangium from the hypha that bears it (fig. 2). The cross-wall may be below or near the sporangial enlargement. Fig. 4 shows what appears

to be a young intercalary sporangium. As the sporangium enlarges (fig. 3) the protoplasmic meshes become smaller and smaller till they are only visible with an oil-immersion objective. Cleavage begins at this time. The furrows start near the periphery and extend inward. Figs. 6 and 7 in pl. 27 show two sections through a young sporangium and fig. 8 a section of another sporangium showing a slightly later stage in cleavage. Figs. 9–11 are three successive sections through a slightly older sporangium showing later stages in the development of the furrows. The protoplasm soon becomes divided into masses of various sizes and shapes (figs. 5 and 13). During the early stages of cleavage the furrows are densely filled with a slime that takes the saffranin and haematin stains very readily. The slime soon disappears and during later stages (pl. 27, figs. 5, 9–11, and 13) the furrows seem entirely free from slime. The nuclei retain the same characteristics during all stages of sporangial development. They are densely granular with several nucleoli (below in fig. 10).

In most sporangia the spores become sphaeroidal and almost completely fill the sporangium (pl. 27, figs. 14 and 15), but in some sporangia large masses of protoplasm seem to escape further cleavage and thus give rise to the very large spores often observed in examining mounts from fresh material. The mature spores are always multinucleate (pl. 27, fig. 12), the nuclei having the same structure as those observed in the sporangium during its development.

The development of the spores in the sporangia more closely resembles that of *Sporodinia* (Schwarze (7)) than any other form for which we have a full account. Vacuoles at no time seem to take any direct part in the formation of the cleavage furrows.

Indications of Relationship

The structure of the hyphae and the method of sporangium and spore formation all point definitely to a phycomycetous relationship. The only characteristic that is not definitely phycomycetous is the septation of hyphae in the sporangiocarps (and occasionally in older hyphae), but similar septations occur in the sporangiophores of *Sporodinia grandis* and the older mycelia of certain mucors. Among the Phycomycetes its closest relatives are to be

found among the Mucorales. The absence of the columella at once suggests *Mortierella,* and in looking over papers on *Mortierella* one must be impressed by the many similarities between *Mortierella* and *Endogone malleola.* Especially strikingly was this observed in Bachmann's (2) account of spore germination and the development of anastomoses by *M. van tieghemi.* Kauffman (6) in *M. bainiere* observed the development of somewhat moniliform enlarged cells closely resembling structurally the moniliform cells formed in culture of *E. malleola.* His cells were formed in the media, while in *E. malleola* these cells may be formed in the media or on the surface of the culture and are developed in greater abundance. The presence of such masses does not seem to be characteristic of the genus *Mortierella,* however, as Dauphin (4) does not mention them in his discussion of the genus.

No trace of a sexual stage was found, nor have any been found, for any species of *Endogone* of this sporangial type. Thaxter (8) has found one case through which he could definitely connect the chlamydosporic types of *Endogone* with the sexual types, but whether a close relationship exists between the sexual types of *Endogone* and the sporangial types can only be settled by further observations. In this connection, however, it might be noted that both Atkinson (1) and Bucholtz (3) from their work on sexual types conclude that these are closely related to *Mortierella,* and Bucholtz (3) and Thaxter (8) point out also the probable relationships between these sporangial types and *Mortierella.* The writer's observations confirm this supposition. Since all types of *Endogone* show such definite relationships to *Mortierella,* it seems probable that the sporangial types also may be shown to be only stages in the development of sexual *Endogones.* With the information at hand, it seems as if *Endogone* should be removed from the Hermiascineae, where it has been placed by many (see Atkinson (1), p. 11, for summary), and placed in the Mucorales.

SUMMARY

1. There is great variation in the sporangiocarps of *E. malleola.* Large and small sporangial types of fructifications are noted.

2. The spores germinate readily in water.

3. By means of anastomoses larger distributive hyphae develop.

4. Protoplasmic movement is very rapid in the distributive hyphae.

5. Large masses of firmly interwoven moniliform cells superficially resembling sporangiocarps develop on cultures, but true sporangiocarps were never produced.

6. The development of the sporangia is entirely phycomycetous.

7. A close relationship between *E. malleola* and *Mortierella* is noted.

I wish to express my indebtedness to Dr. Roland Thaxter for suggestions during the progress of my work and for reading a first draft of this paper and adding more helpful suggestions. Thanks are also due Dr. Thaxter and Dr. E. A. Burt for identifications and Prof. T. J. Fitzpatrick for proof-reading the paper.

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DESCRIPTION OF PLATES

PLATE 26. PHOTOMICROGRAPHS

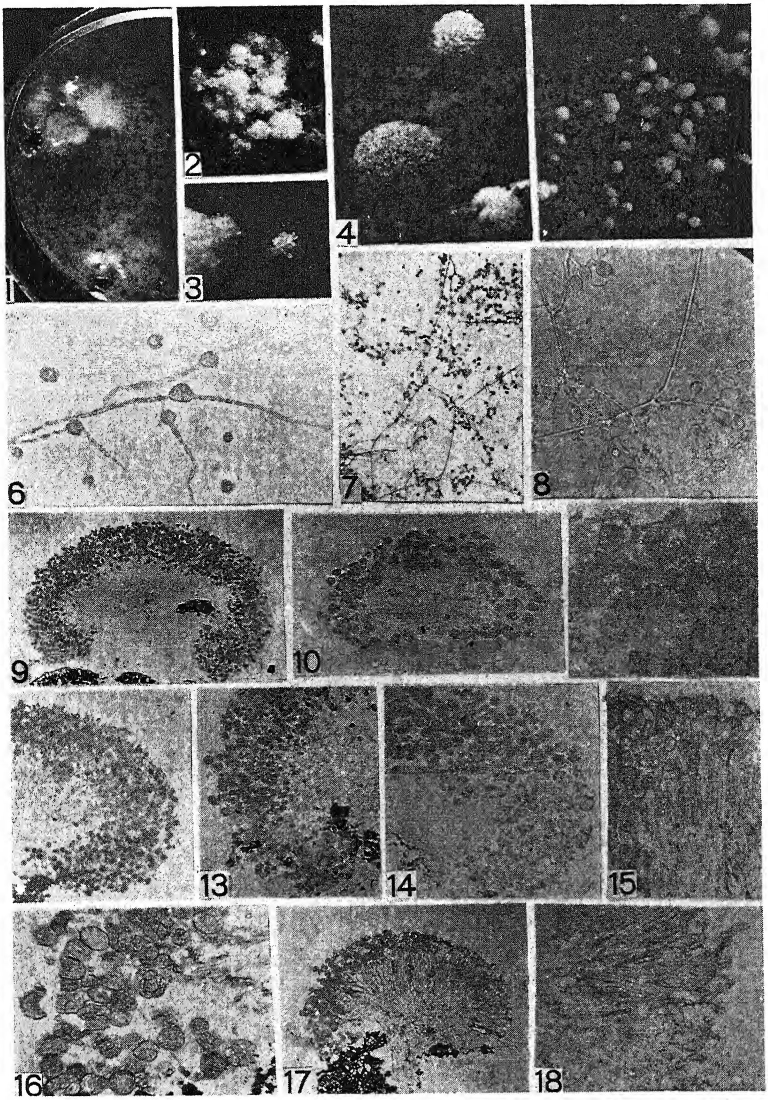
1. Culture of *Endogone* on corn-meal agar when about a week old. Moniliform cells appearing; × 5/9.

2. Higher magnification of moniliform cells on culture shown in fig. 1; × 12.

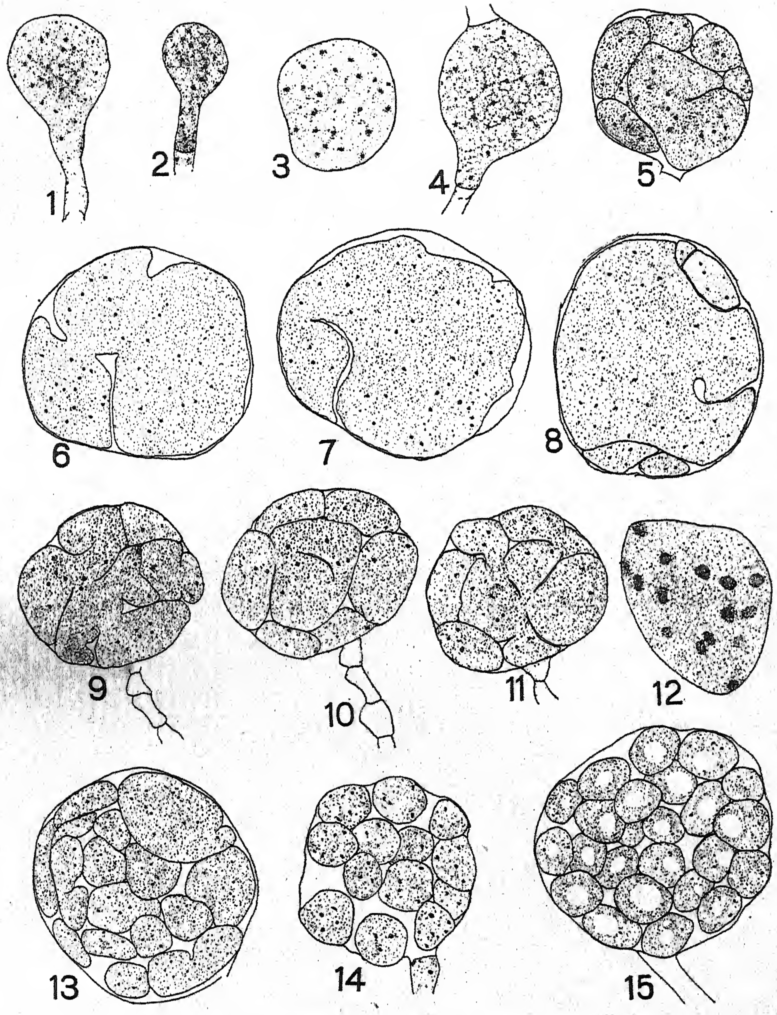
3. Very small sporangiocarp; × 12.

4. Mature sporangiocarps; × 7.

5. Masses of moniliform cells on older agar culture; × 7.



ENDOGONE MALLEOLA HARK.



Endogone malleola Hark.

6. Hyphal anastomoses in 24 hours old hanging drop culture; × 136.

7. Portion of a thickly "seeded" hanging drop culture 2 days old; × 55.

8. Higher magnification of lower central portion of field seen in fig. 7 showing branching and anastomosing of distributive hyphae; × 136.

9. Median cross section of typical mature sporangiocarp; × 15.

10, 12, 13, 14. Parts of sections of mature sporangiocarps showing variations in size of sporangia and arrangement of parts; × 30.

11. Portion of outer layer of a sporangiocarp of the small sporangial type to show superficial hyphae; × 136.

15–18. A young sporangiocarp of the small sporangial type (17) showing to the left (16) sporangia in all stages of development, to the right (18) radiating hyphae ending in moniliform cells and to the center (15) a transition from moniliform cells to young sporangia; fig. 17 × 30; figs. 15, 16, 18 × 136.

PLATE 27. CAMERA LUCIDA DRAWINGS

1. Young sporangium before formation of cross wall separating it from sporangiophore; × 555.

2. Young sporangium cut off by cross wall; × 555.

3. Larger sporangium before cleavage begins; × 555.

4. Intercalary cell showing characteristics of young sporangium; × 555.

5. Sporangium showing late stage in cleavage; × 555.

6, 7. Two sections of sporangium showing a very early stage in cleavage; much slime was present in furrows; × 555.

8. Slightly later stage in cleavage of sporangium; × 555.

9, 10, 11. Three sections of the same sporangium showing development of cleavage furrows; × 555.

Two nuclei and cytoplasmic structure shown below in fig. 10; × 1500.

12. One spore; × 1500.

13. Late stage in cleavage; × 555.

14. Mature (young) sporangium (small type); × 555.

15. Mature (older) sporangium (large type); × 555.

DECAY OF LUMBER AND BUILDING TIMBERS DUE TO PORIA INCRASSATA (B. & C.) BURT

C. J. Humphrey

(With Plates 28–30)

Introduction

During the past twelve years the writer has been accumulating information and material on the decay of timber used for building purposes. These investigations have covered the entire United States. Part of the data have been secured through correspondence at the Madison Laboratory of the Office of Forest Pathology, coöperating with the Forest Products Laboratory, which has been the clearing-house for most of the inquiries of this character made to the Federal government, and part by special field work, mainly throughout the eastern and southern states and the Pacific Coast region. These investigations cover lumber yards and all types of buildings from the simplest structures to large industrial plants.

The greatest economic losses from decay in buildings probably occur in those structures where the air is highly humidified either by artificial means or through manufacturing processes, such as in weave sheds and dye sheds in the textile industry, paper mills, etc. A limited number of fungi have been found doing extensive damage in this type of buildings, but *Poria incrassata*, the fungus here under discussion, has not yet been found developing under these conditions, although it is frequent in other buildings.

The decay due to *Poria incrassata* is quite similar to that produced by *Merulius lachrymans* and has probably been frequently confused with it, especially since the fungus is often found in a sterile condition. In common with *Merulius lachrymans*, infections first start in moist, cool situations, preferably on timber beneath floors which is either in contact with the ground or close to it. On the whole it is of greater economic importance than any of the members of the Merulius group in the United States.

HISTORICAL

In his monograph on "Merulius in North America,"[1] Dr. E. A. Burt first used the name *Poria incrassata*. As synonyms of this he includes *Merulius incrassatus* B. & C. described in 1849 from pine stumps in South Carolina, *Merulius spissus* Berk., also from South Carolina (1872), and *Polyporus* (*Poria*) *pineus*, described by Peck from wood and bark of pine, Selkirk, New York, in 1888. In 1913, Dr. Adeline Ames described a fungus from Auburn, Alabama, which was decaying pine and cypress woodwork in the Engineering Building of the Alabama Polytechnic Institute, calling it *Poria atrosporia* Ames on account of the dark spores. Since then the fungus has not appeared in literature in connection with the decay of timber.

The writer has compared the types, or fragments of the types, of all the above species. Although the hymenium is for the most part disorganized, and the dry specimens collapsed and friable, there can be no doubt that we are dealing with but a single species. The spores are copious in all the collections and are similar in color, shape, and size. Representative specimens from the writer's collections of *Poria incrassata* were also referred to Miss E. M. Wakefield at the Kew Herbarium, London, who kindly compared them with the type of *Merulius incrassatus* B. & C. Her valued opinion likewise confirms the findings of the writer in this respect. The name *Poria incrassata* (B. & C.) Burt, having priority, must then be used to designate the fungus.

DESCRIPTION OF THE FUNGUS

No adequate description of the fungus in the fresh condition has ever been published. Berkeley and Curtis (Grevillea **1**: 70. 1872) state that *Merulius incrassatus* is "dirty white and slightly silky; substance thick, fleshy, folds forming minute shallow brownish pores." On the same page in Grevillea, Berkeley describes *Merulius spissus* as "several inches across, at first membranaceous with shallow pale pores about 1/24 of an inch in diameter, then much elongated and forming a dark brown mass." Peck (New York State Mus. Rept. **41**: 78. 1888) states that *Poria pinea* has

[1] Ann. Mo. Bot. Gard. 4: 305–362. *pl. 20–22, figs. 1–39.* Nov., 1917.

"the thin subiculum and margin whitish, sometimes tinged with yellow; pores . . . dingy whitish, becoming blackish where bruised or wounded, the whole plant becoming blackish or blackish-brown in drying." Ames, working with dry material, described *Poria atrosporia* (Bot. Gaz. **55**: 397–399. 1913) as "pale umbrinous," with "pores deep fuligineous because of the abundance of dark spores."

These descriptions are entirely too meager for one to gain a true conception of the fungus, and the only satisfactory way to ascertain the identity of the above species was to make a detailed comparison of the type or co-type material. The organism assumes many different aspects (Pls. 28–30) both in the sterile and fruiting condition, in accord with changes in the environment. The writer has found the species in all stages of development, but only in rare cases are all the characters combined in a single collection.

The most striking character of the fresh fruit-bodies is the color, which varies in specimens developed under partial illumination, such as obtains in the woods or in partially lighted basements, from orange to pale olivaceous (Pl. 28, Fig. 1). When growing entirely in the dark beneath floors no trace of orange is present. However, when the mycelium grows through the cracks in the floor into a lighted room, it may form cushions of orange mycelium. This has been noted in two instances, the one case in a warehouse and the other in an empty lumber storage shed open in front. Orange mycelium has also been observed in partially illumined basements. Where fructifications have been observed on the upper surface of the floor, these have been brown.

The following field notes present the characters and appearance of the fungus when developing under different conditions:

Field No. 6671. On side of rotten prostrate charred trunk of *Thuya plicata* along roadside in woods, Shelton, Washington, October 4, 1910.

Plant effused in elongate patches up to 12 inches or more long, 4 to 8 inches wide, and 1.3 cm. thick, much contorted when overgrowing a mossy surface. Young plants orange with a pallid-yellowish margin. When mature they become pale-olivaceous with the ultimate margin pallid-yellow and the adjacent surface orange, shading into olivaceous over the mature pore surface. Margin determinate but irregular, tomentose.

Pores subangular or linear-elongate and then up to 2 mm. in length and

1/2 to 2/3 mm. in width, up to 7 mm. deep, orange tinged over the lower half. Dissepiments entire, thick, fleshy, much thicker than the diameter of the pores in young plants.

Subiculum 1 to 8 mm. thick, fleshy-fibrous, hygrophanous, breaking with a succulent, brittle fracture; with a narrow orange zone followed by a narrow whitish zone just beneath the pores contrasting with the hygrophanous lower layers. At the thickest portion white over the lower half and hygrophanous-white above.

No. 7833. Beneath Douglas fir flooring laid over sawdust. Lumber storage shed near Seattle, Washington. October 13, 1915.

Plant succulent, fibrous-fleshy, moderately tough, easily separable from the substratum, light olive-gray (R)[2] when young and fresh, becoming near to sepia (R) as it matures, and finally brownish-black or black (Pl. 28, Figs. 1–3; Pl. 29, Fig. 1).

Pores up to 1 cm. deep, averaging 2 to a millimeter, subangular to somewhat sinuous, olivaceous at edge, sepia within. Dissepiments much interrupted and of uneven heights.

Subiculum 2 to 3 mm. thick, subgelatinous, with a fibrous, whitish to cremeous layer just beneath the pores, otherwise watery-brown, somewhat lighter in color than the pores, attached to substratum by conspicuous tufted fibrils which make the plant readily separable from its host. In the mature plant there was no suggestion of orange, although the mycelium growing up through the cracks in the floor was distinctly of this color. On drying, the plant becomes very light in weight, and coarsely frustulate. In this condition it is very fragile and easily detached from the substratum on jarring. On account of its succulent character when fresh, it is soon destroyed by molds and insects.

When the fungus fruits on the upper surface of flooring or on the exposed surface of interior finish in buildings, the fructifications are much firmer in texture (Pl. 28, Figs. 4, 5, and 6), and often develop a thick whitish subiculum of compact vertical hyphae. This cracks widely in drying, the context then being in sharp contrast to the brownish to blackish-brown pore surface. The margin in such cases is broadly sterile, puberulent, dirty-whitish, sometimes tinged with orange. The youngest pores are mere pits, which are very shallow. An immature collection (Pl. 28, Fig. 8), with the pores just forming, taken from beneath a building in Washington, D. C., varied, in the dry condition, from ochraceous-buff (R) to cinnamon-buff (R) over the pore surface, with a broad sterile margin near to light-buff (R).

Other collections, more or less abortive in character, remind one of compact liver (Pl. 28, Fig. 5), both in color and consistency. Such specimens shrink markedly in drying, separate from the sub-

[2] Ridgway, Robert. Color standards and color nomenclature, 1912.

stratum, especially at the margins, and become unrecognizable except to one particularly familiar with the organism.

The mycelium frequently forms extensive fan-shaped sheets (Pl. 30, Figs. 1 and 3) particularly when developing between two adjoining timbers. This mycelium is whitish when young, but becomes tinged with yellowish-olive to brownish as it ages. Such sheets of mycelium are very characteristic and are present on many of the samples of decayed building timbers sent in to the laboratory for identification. In conjunction with cultures derived from the infected wood they furnish a ready means of identifying the organism.

In some collections rhizomorphs are present. When young these are white and very small (Pl. 29, Fig. 2). As they mature they become brown to brownish-black and are frequently flattened, intimately imbedded in the mycelial sheets, and closely appressed to the decayed wood (Pl. 29, Fig. 3). They are largest near the ground and may appear as heavy root-like growths which sometimes spread out as a foot-like attachment where they arise from the soil. Only rarely have the smaller strands been observed originating from the margin of the fructifications. Flask cultures of the fungus on wood (Pl. 30, Fig. 2), however, produce an abundance of the smaller white strands, which definitely proves their association with the species. The large brown rhizomorphs associated in nature with the mycelial sheets likewise demonstrate their organic connection with this species. This has been further verified by positive tissue cultures directly from a rhizomorph.

In structure the larger strands are very similar to the rhizomorphs described and figured by Falck [3] for *Merulius lachrymans*. They are composed of more or less parallel hyphae, the outer cortical layers being dark brown and thick walled and the medulla consisting of hyphae of varying size, many of these being differentiated into large conducting tubes (Pl. 29, Figs. 4 and 5).

The spores are very characteristic. They are elliptical to somewhat oval (Pl. 29, Fig. 6) and vary in color from dusky-olivaceous to dusky-brown under the microscope. In mass they are Prout's

[3] Falck, Richard. Die Meruliusfäule des Bauholzes. *In* Möller, A. Hausschwammforschungen, Heft. VI, p. 172 et seq., pl. 10, 1912.

brown (R). The more prevalent sizes are 6.5–7 x 8–10 μ. No other species of *Poria* is known to produce spores of this type.

The writer has had no opportunity of examining the structure in a fresh condition, and since the fungus dries to a collapsed, fragile mass it is difficult to study. In dry specimens, as Burt indicates, the tramal hyphae have a close, parallel arrangement and are usually brownish-tinged, along with the rest of the context. In a narrow layer just beneath the pores the hyphae are compact and in some cases have a tendency to parallel arrangement in the direction of the pores. As they approach the substratum they become loosely interwoven and frequently distinctly brownish.

The odor of the dry material is very marked in the case of the more succulent fruit-bodies, and reminds one of drying slippery-elm bark or certain of the fleshy Hydnums in the dry state.

CULTURE STUDIES

Spore germination tests with *Poria incrassata* have never been successful, since there was no opportunity in the field to work with fresh spores. Fruit-bodies sufficiently fresh for casting spores have only been met with four times and the spores obtained did not prove viable after returning to the laboratory several weeks later. Brown spores are, as a rule, difficult to germinate. In the case of *Merulius lachrymans,* it has been found, however, that freshly cast spores will germinate readily on malt agar, and this may be the case also with *Poria incrassata.*

Many pure cultures have been made, however, from decayed wood and in one case from a rhizomorph. These have been secured from about fifteen sources. None of the cultures have yielded fructifications of even an abortive type. They do, however, in some cases show the characteristic orange color reaction of the fungus in a minor degree.

Young cultures are pure white. On malt-extract agar an abundant mycelium is produced which usually takes on more or less of a radiate, strand-like character (Pl. 29, Fig. 7). As the cultures age they become somewhat tinged with yellowish-olive and occasionally at the upper limits of growth in a test tube or flask they may become orange-tinged. On wood in flasks they produce a

moderate white growth with numerous small, white strands closely appressed to the wood.

The rate of growth at different temperatures has been determined, using malt-extract agar of the following composition:

Extract of 1 pound lean beef in distilled water	1000 cc.
Löfflund's malt extract	25 gms.
Agar-agar	20 gms.

(Carefully filtered, but reaction not adjusted.)

Twenty cubic centimeters of the medium were poured into a 100-mm. Petri-dish and inoculated at the center with a small rectangle of mycelium with adhering agar cut from another Petri-dish. The cultures were prepared in duplicate and incubated for 4 weeks at 12°, 16°, 20°, 24°, 28°, 30°, 32°, and 34° Centigrade. The growth was measured at intervals of a week and recorded as radial growth in millimeters. The results are shown in Table 1.

TABLE 1

EFFECT OF TEMPERATURE ON MYCELIAL GROWTH OF *Poria incrassata*

Temperature (Deg. C.)	Age of inoculum (Days)	Radial growth in millimeters				Character of growth
		1 wk.	2 wks.	3 wks.	4 wks.	
12	—	0	3.5	5.5	9	Fluffy white; somewhat radiate.
16	15	6	16	27	42	Fluffy-radiate; white; somewhat zonate.
20	20	9	33.5	47+	—	Fluffy-radiate; white, creamy at center; somewhat zonate.
24	—	14	47	—	—	Fluffy-radiate; white
28	20	20	47+	—	—	Fluffy-radiate; margin white, older growth fawn to pinkish-violet.
30	15	30	37	47+	—	Fluffy-radiate; margin white shading into brownish then violet over center.
32	—	9.5	21	32.5	46	Fluffy-radiate; at first white, then margin white, shading into yellow and finally pinkish-cinnamon over center.
34	21	0	0	0	0	

In Petri-dish culture the fungus shows predominantly a fluffy-radiate growth which will cover a 100-millimeter dish in about ten days at 28° C., which appears to be the optimum for the fungus, although growth is nearly as good at 24° C. The color

changes, varying from yellow to pinkish-cinnamon as the mycelium ages, are quite conspicuous at temperatures of 28° C. and above.

The action of the fungus on various woods, comprising representatives of thirteen genera of conifers and twenty-five genera of broadleaf trees, has been tested by means of laboratory cultures in 2-liter Erlenmeyer flasks (Pl. 30, Fig. 2). The cultures were prepared as follows:

A quantity of small spruce and hemlock or mixed hardwood blocks, depending on whether coniferous or broadleaf species were under test, were soaked in water to saturation and sterilized in the autoclave at 15 pounds steam pressure for about 3 hours. This treatment forced out the excess water and put the blocks in good moisture condition for decay. A layer of these was then placed in the bottom of the flask. On top of these were placed from ten to twelve of the blocks which it was desired to test. These were, as a rule, 2 inches long and ¾ x ¾ inch in section. They had previously been dried at about 102° C. for 48 hours and weighed.

After the insertion of the test blocks, another layer of culture blocks was added to the flask, together with a pledget of wet cotton. The flasks were then capped with oilcloth and cotton and sterilized on three successive days at 100° C. for periods of 45, 30, and 30 minutes, respectively. They were inoculated by emptying into the flask a culture of the fungus developing on a bean pod. The tests were run for two years, but since a number of the flasks required reinoculation and the further addition of water several months after starting, the effective test period for these was actually less than the period indicated.

At the end of the period the test blocks were removed, dried as before, and weighed. The resulting loss in weight was taken as the criterion of decay under the conditions of test outlined, the percentages being computed on the basis of the original, dry weight. The results on the heartwood are given in Tables 2 and 3. In judging the condition of the wood it should be kept in mind that losses of 50 per cent and over mean that the timber was thoroughly decayed, and, as a rule, was sufficiently friable when dry to be pulverized between the fingers.

TABLE 2

DURABILITY OF THE HEARTWOOD OF CONIFEROUS SPECIES AGAINST

Poria incrassata

Species	Laboratory No.	Maximum loss in weight in 24 mos. (per cent)
Abies amabilis, Silver fir	118	47.8
Abies concolor, White fir	83	34.4
Abies grandis, Lowland white fir	224–16	43.5
Chamaecyparis lawsoniana, Port Orford cedar	319–76	39.6
Chamaecyparis nootkatensis, Alaska cedar	318–4	1.8
Juniperus californica, California juniper	142	34.8
Juniperus occidentalis, Western juniper	121	56.8
Juniperus pachyphloea, Alligator juniper	463–16	24.2
Larix europaeus, European larch	126	51.5
Larix occidentalis, Western larch	122–	46.4
Libocedrus decurrens, Incense cedar	318–11	0.9
Picea canadensis, White spruce	60	37.0
Picea engelmanni, Engelmann spruce	15–25	19.4
Picea rubens, Red spruce	226–84	19.4
Picea sitchensis, Sitka spruce	325–88	24.6
Pinus contorta, Lodgepole pine	10–2	59.8
Pinus echinata, Shortleaf pine	203–1	38.7
Pinus lambertiana, Sugar pine	122	24.2
Pinus monticola, Western white pine	224–2	43.3
Pinus palustris, Longleaf pine	176–38	55.2
Pinus ponderosa, Western yellow pine	224–21	70.2
Pinus resinosa, Norway pine	127	54.6
Pinus rigida, Pitch pine	156	57.8
Pinus strobus, White pine	120	31.2
Pseudotsuga taxifolia, Douglas fir	354–5	37.2
Sequoia sempervirens, Redwood	....	28.6
Sequoia washingtoniana, Bigtree	40	37.5
Taxodium distichum, Bald cypress	14	30.1
Taxus brevifolia, Pacific yew	263–	8.9
Thuya occidentalis, Northern white cedar	124	42.5
Thuya plicata, Western red cedar	224–8	40.8
Tsuga canadensis, Hemlock	226–9	21.0
Tsuga heterophylla, Western hemlock	13–4	13.4
Tsuga mertensiana, Mountain hemlock	136	29.0

In presenting these durability figures, the writer does not wish to draw any comparison between the different species, since the cultures were not under sufficiently uniform control, particularly of moisture, to warrant it. The point to be emphasized is that we are here dealing with an omnivorous saprophyte which is capable of attacking and destroying almost all of the commercial woods of

TABLE 3

DURABILITY OF THE HEARTWOOD OF BROADLEAF SPECIES AGAINST

Poria incrassata

Species	Laboratory No.	Maximum loss in weight in 24 mos. (per cent)
Acer macrophyllum, Broadleaf maple	160	67.5
Acer saccharinum, Silver maple	135	66.4
Aesculus octandra, Yellow buckeye	149	77.3
Amelanchier canadensis, Serviceberry	226–102	75.0
Betula lenta, Sweet birch	197–27	73.6
Castanea dentata, Chestnut	245–	19.6
Catalpa speciosa, Hardy catalpa	104	27.3
Celtis occidentalis, Hackberry	211–	76.2
Fagus atropunicea, Beech	....	...
Fraxinus americana, White ash	256–3	68.6
Fraxinus biltmoreana, Biltmore ash	161–	67.4
Fraxinus lanceolata, Green ash	223–4	63.2
Fraxinus nigra, Black ash	219–	75.2
Gleditsia triacanthos, Honey locust	368–22	62.6
Hicoria glabra, Pignut hickory	72439	67.2
Hicoria pecan, Pecan	176	49.9
Ilex opaca, American holly	226–70	72.0
Juglans cinerea, Butternut	226–131	54.5
Juglans nigra, Black walnut	608	42.1
Liquidambar styraciflua, Red gum	72559	52.5
Liriodendron tulipifera, Yellow poplar	226–14	29.0
Magnolia fraseri, Fraser umbrella	226–122	67.5
Nectandra rhodei, Greenheart	....	30.9
Nyssa sylvatica, Black gum	226–72	59.2
Platanus occidentalis, Sycamore	153	67.6
Populus deltoides, Cottonwood	368–1	73.4
Prunus pennsylvanica, Wild red cherry	226–45	78.2
Prunus serotina, Black cherry	197–33	64.6
Quercus alba, White oak	72919	26.5
Quercus Californica, California black oak	166	55.0
Quercus densiflora, Tan oak	15	76.0
Quercus garryana, Oregon oak	319–42	10.6
Quercus macrocarpa, Burr oak	211–27	48.5
Quercus michauxii, Cow oak	73009	64.9
Quercus nigra, Water oak	163	62.8
Quercus prinus, Chestnut oak	226–93	42.8
Rhus hirta, Staghorn sumach	211–	66.9
Robinia pseudacacia, Locust	226–131	48.9
Salix nigra, Black willow	132	78.1
Sassafras sassafras, Sassafras	226–127	57.3
Tilia americana, Basswood	73189	82.5
Ulmus pubescens, Slippery elm	211–6	55.9

the United States. Even such reputedly highly durable woods as cedars, cypress, junipers, sequoias, catalpa, greenheart, black locust, sassafras, white oak, black walnut, and black cherry are severely attacked, and in some instances completely destroyed.

The fact that commercial losses have so far been limited to coniferous timber is purely a matter of circumstance, not of potentialities. The writer has several records, however, in which broadleaf species have been severely attacked. In one case nail kegs, presumably constructed of broadleaf timber, rested on a decayed floor and were completely destroyed; in another instance an oak crate, containing a steel cylinder, was placed on the floor in an engine room of a Georgia planing mill, and although the floor was dry and showed no apparent rot, within three or four months the under part of the crate was rotten and the cylinder was covered with mycelium "as though it had been wrapped in cotton batting"; a third instance was of red oak flooring in a dwelling in Tennessee.

ECONOMIC FEATURES

Decay in Lumber Sheds and Stored Timber

The organism has an unprecedented record for destructiveness to timber used for building construction. The lumber industry is a particularly heavy sufferer. Twenty outbreaks in lumber storage sheds are known, most of them being very severe. Four of these were on the Pacific Coast, ranging from Seattle to San Francisco, and the remainder in the states of Alabama, Georgia, Louisiana, Mississippi, and eastern Texas.

It is impossible to trace the origin of these infections, but the conditions which have favored their development are obvious in most cases. Many of them had become widespread and very destructive before they were called to our attention. As a rule, the sub-floor timbers or the foundations for the lumber piles were infected first, the fungus then passing up into the flooring, where present, and ultimately into the base of the piles (Pl. 30, Fig. 4). Some of the sheds were built on swampy ground, and although the foundations were sufficiently elevated to secure air circulation, this did not reduce the moisture enough to prevent the spread of

the fungus from the soil upward. In such cases artificial drainage helped to correct the difficulty, but usually was not a remedy after the decay had once started. In other cases the foundation timbers were close to the ground, or in contact with it, a condition which frequently leads to decay in building timber, regardless of whether the soil is obviously moist or not.

Several instances have been noted where flooring in lumber sheds has been laid on stringers two to three inches thick resting directly on the soil or on various filling materials, such as cinders, sawdust, etc. This has invariably led to decay and frequently resulted in severe losses in lumber stocks stored thereon, for once the infection has passed upward into the flooring, it is readily transmitted to the stored material by contact. Kiln-dried stock appears to be as susceptible to infection as air-seasoned material.

In one case the mycelium was observed to pass upward to a height of five feet in a bundle of Douglas fir stepping end-piled on such a decayed floor. In other instances infection has been found running up posts in lumber sheds for six feet or more, and in some cases producing fructifications on them.

In only two instances has infection in the open yard been noted. In one of these cases about 20,000 feet of 6″ x 6″ sap pine were destroyed. This was piled on very low foundations. The fungus (probably *Poria incrassata,* since this was the organism prevalent in other parts of the yard) passed upward into the piles for 8–10 feet, although the timbers were separated by crossing strips 1 inch thick. After disposing of the infected wood for fuel, the new foundations were built somewhat higher and no further trouble was experienced with piles in the open.

The direct losses due to damage to lumber sheds and to the destruction or degrading of timber in storage are difficult to estimate, since detailed records are rarely kept.

At one retail yard in Alabama (Pl. 30, Fig. 4) the losses were estimated at between $1,000 and $2,000, occasioned by sporadic infections over a period of about seven years. This includes the total loss of two carloads of 6″ x 6″ pine timbers, about 20,000 feet b.m., just mentioned. At this yard considerable repair work was done both in the frame office building and in the storage sheds before the fungus was brought under control.

In a lumber yard at Houston, Texas, severe decay occurred in pine lumber close-piled in a shed for three to four months. About 15,000 feet of lumber were destroyed, as well as thirty to forty thousand heart cypress shingles. The total loss was about $500.

At another yard in south Georgia an estimated loss of $10,000 is reported.

The losses at certain other plants may be far in excess of these, judging from personal inspections made by the writer and information furnished by operators. The cost of replacing foundation timbers which have failed through decay is very often merged in the general upkeep, and this is particularly true where timbers here and there are replaced as failure occurs. Likewise considerable amounts of decayed stock are probably discarded, without particular attention, at the time piles are broken down. If a record were kept of the actual losses thus sustained, both in time and material, the results would be startling in many cases. In the aggregate the losses must run into the hundreds of thousands of dollars yearly when we take into consideration foundation timbers and other supports, flooring, stock, and the labor involved in repairs.

Decay in Buildings

The greatest damage, however, is not to the lumber dealer, but to the ultimate consumer of the infected products, for in all probability many of the outbreaks in buildings are directly traceable to infections starting in the lumber yard. While decayed stock would not normally be sold for structural purposes, nevertheless a dealer does not usually cull his product more closely than absolutely necessary to satisfy business standards. Incipient infections could readily pass the usual inspection and would constitute just as severe a menace as the more conspicuous decay.

The fungus is known to be widely distributed in buildings throughout the country (Pl. 30, Figs. 5 and 6). The writer has investigated, or has records of, more than thirty cases. The organism is a domesticated species and reaches its best development in buildings. Its occurrence in the woods is comparatively rare, but there is little doubt that infections in lumber yards and buildings have originally come from the forest. Undoubtedly as

our knowledge of the fungous flora of the forest increases a wider distribution and prevalence of the organism will be demonstrated.

At the present time infections in buildings (outside of lumber storage sheds) are known from at least thirteen states, principally in the southern United States and Pacific Coast region. Many of these buildings are frame residences, but other structures, such as stores, factories, warehouses, and churches, fall a ready prey as well. The damage to many of these buildings has been extensive.

In all cases the outbreaks have started beneath the first floor, particularly where this has been placed over moist ground. It is not necessary, however, that the sub-floor timbers and floors be close to the ground, for in the moist climate of the Gulf states houses built over apparently dry sandy soil and well ventilated beneath have suffered heavy losses. In frame buildings the fungus spreads from the sub-floor timbers up the walls and usually first becomes evident by the rotting and shrinking of baseboards, panels, wainscoting, door casings, etc. The shrinkage, and consequent opening of the joints, exposes the whitish mycelium behind. These are very conspicuous features.

Not only does the fungus run up the walls behind interior finish and between the studding of plastered walls (Pl. 30, Fig. 5), but it will also readily pass up simple interior partitions consisting of half-inch ceiling lumber nailed on either side of upright strips, and in one case it was found extending up a partition of single thickness half-inch beaded stock placed vertically. In one dwelling the organism passed up a double interior wood partition to the ceiling of the room, a height of about ten feet. In another case it extended up a similar partition between two rooms, each containing a coal stove operated during the entire winter, for a distance of six to eight feet. In one of the rooms the stove was set as close to the partition as safety would permit.

How the fungus can obtain sufficient moisture under such circumstances has not been determined, as rhizomorphs are usually lacking in such places. Invariably, however, rather compact sheets of fan-shaped mycelium form within the wall cavities and this may function in water conduction. Likewise, the further possibility of water production by the disintegration of the fiber in the decay processes offers a hypothesis worthy of further investigation.

Not alone does the fungus destroy the timber of the buildings, but it will also readily infect objects in contact with the decayed wood. Thus window sash, doors, wall board, nail kegs, tarred roofing (Pl. 30, Fig. 3), asphalt shingles, cement-asbestos shingles, galvanized fencing wire, and various documents and minor items stored in infected buildings have been destroyed or damaged.

The fungus works very rapidly and for this reason has occasioned serious concern in more than one household. In some instances tenants have complained of the floors breaking through in walking about, or the post of a bed has crushed through, or a door has fallen from its hinges. These events are at the least disconcerting, although they may not be particularly dangerous.

At the University of Florida a large floor area in one of the modern brick buildings was destroyed and several large uprights attacked within two years. In a brick store building six years old at Kissimmee, Florida, the floor had rotted out, and the new flooring put in had also rotted through in places within a year after replacement. A frame residence at St. Lucie, Florida, suffered severe loss in three years, and by five years about one fourth of the house was visibly affected. In a residence at Thomasville, Georgia, decay started in a property twenty years old and extended to a height of about 14 feet, rotting sills, joists, studding, siding, etc., necessitating repairs amounting to \$850. A cottage at Louisville, Kentucky, built about three years, suffered badly from the decay of sub-floor timbers, flooring, and casings, with a loss of about \$150. A residence in Memphis, Tennessee, required several hundred dollars for repairs. In a fine residence at Shreveport, Louisiana, a considerable part of the front wall and 750 feet of flooring had to be replaced within three years after construction, necessitating an expense of about \$3,000. In a store at Baton Rouge, Louisiana, heart cypress ceiling laid over a brick wall lasted but six months.

The facts at hand thus indicate that *Poria incrassata* is a particularly destructive and rapid-growing organism which attacks practically all species of wood. The only timbers which have been observed rotting under natural conditions are, with the exception of the hardwood material previously mentioned, species of south-

ern pine, Douglas fir, and cypress. This is the case since these timbers are the principal structural material in the regions where the fungus prevails. The organism is spreading rapidly, mainly throughout the southern and Pacific Coast states. It is becoming more or less epidemic in character and is apparently introduced into new buildings in certain cases through the use of infected lumber. The situation is becoming so acute that it is necessary to take immediate steps to bring the many infections under control and eradicate them wherever possible.

The severely decayed wood is brown and breaks up into irregular chunks by the formation of shrinkage cracks both across and in the direction of the fiber, the crevices frequently containing sheets of white mycelium.

Since the organism apparently thrives under conditions which at times are not favorable to the growth of most other fungi, it assumes special importance in buildings, and recommendations for control must take into consideration all the factors in the life history.

CONTROL MEASURES

Prevention

In controlling this fungus our first attention should be directed toward preventing new infections. The two main points to consider in this connection are, first, an improvement of the sanitary condition of lumber yards, particularly with respect to the presence of infected or rotting debris about the yard which may serve as a source of infection, and, second, suitable changes in building design, so as to eliminate, as far as possible, the more favorable conditions for fungus attack.

In every case timber storage yards should be kept as free as possible of all decayed material and weeds should be kept down, as these impede free air circulation. Surfacing the soil with cinders is always highly advisable and wherever the yards are located on wet ground, or where subject to periodic wetting, they should be properly drained. Lumber storage sheds can be rendered fungus-proof by using for the foundations, both for the sheds and the piles, either such substances as concrete, brick, or stone, or

timber *thoroughly* treated with an antiseptic, such as coal-tar creosote, zinc chloride, or sodium fluoride. If it is not considered feasible to make the entire foundation of one or the other of these substances, at least the piers or blocking upon which the supporting timbers rest should be of this type of material. This will prevent the fungus from passing upward from the soil. The foundation should be 12 to 18 inches off the ground and fully ventilated beneath from all sides. When the piles are erected every bit of suspicious wood should be carefully culled and either segregated or destroyed. This is essential, since decay may be started in a pile by the inclusion of even a trace of living fungus.[4]

Since timbers often apparently become infected in the lumber yard, the above precautions will reduce to a considerable extent outbreaks of the fungus in buildings. In addition, however, the consumer has several points to consider in the proper inspection and use of timber after it comes into his hands. These may be summarized as follows:

1. All timber and organic products used in building construction should be carefully inspected for the presence of infection or decay, and suspected material should be rejected.

2. Floors should never be laid directly on the soil or over brick or concrete in basements unless the timber has first been given a thorough treatment with an efficient antiseptic, such as coal-tar creosote, zinc chloride, or sodium fluoride.

3. Other basement or sub-floor timbers which are more or less subjected to moisture should be given some measure of protection by dipping the timbers, spraying, or giving them two to three brush applications with hot coal-tar creosote, or where the color and odor of this substance are objectionable, with a 6 per cent water solution of zinc chloride or a 4 per cent solution of sodium fluoride.

4. Timbers should not be embedded in concrete, brick, or stone walls without leaving ventilation around the ends of the timber by suitable boxing, and even then one of the above preservatives should be carefully applied, using as much preservative as the timber will absorb.

5. If for any reason it is necessary to use untreated timber for the lower floor supports heart material of naturally durable species should be carefully selected. It should be kept in mind, however, that even the highest grade heartwood is far from being immune to decay once this fungus becomes started. The sapwood of none of our commercially available species is suitable for this purpose, and is only to be recommended when thoroughly treated. It can then

[4] A further discussion of this subject will be found in United States Department of Agriculture Bulletin 510, "Timber storage conditions in the eastern and southern states with reference to decay problems," 1917, by the present writer. This bulletin is being revised and will soon be reissued.

be advantageously used on account of the good absorptions and penetrations secured. Dipping, spraying, or brush applications are not dependable where much sapwood is involved.

6. Preference should always be given to thoroughly dry timber. When used in a green or moist condition wood is very apt to become infected, and does not take preservative treatment readily by any of the non-pressure processes.

7. Ample ventilation of basements is very desirable, as a general rule, although where the basement air is somewhat warmer than the outside air, and highly humid, the entrance of the colder outside air may lower the dew point sufficiently to cause condensation of water on the timber. This will naturally lead to even more rapid decay than formerly.

ERADICATION

When the fungus has once gained entrance the only feasible remedy is complete eradication of every trace of infection. This must be thorough. Timbers must be cut back at least two feet beyond all trace of decay to insure success. If the job is not thorough the organism will continue to develop. After eliminating and destroying any of the stored lumber which is visibly infected, the remainder of the stock in the immediate vicinity of the infection area can be further safeguarded by running it through the dry kiln, where such equipment is available. The usual approved methods for kiln-drying coniferous stock will kill any traces of fungus which may have been overlooked, particularly in 1- and 2-inch stock. For larger timbers the treatment will have to be carefully supervised and tested for efficacy, in order to be sure of success.

Sound timbers adjacent to the infection should be surface-treated as just indicated and the adjacent masonry and soil sprinkled or sprayed with the same antiseptic. The timber used in replacement should be selected and handled in the manner already discussed for new construction. Footings or piers in contact with the soil should be either of masonry or thoroughly treated timber. In cases where flooring in contact with the ground has decayed, and the soil is thus thoroughly infected, either concrete or thoroughly treated timber is likewise indicated.

It should be kept in mind that no light preservative treatments will offer full protection, and in no case will they eradicate infections already in the wood.

INVESTIGATIONS IN FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY,
IN COÖPERATION WITH THE FOREST PRODUCTS LABORATORY,
MADISON, WISCONSIN

DESCRIPTION OF PLATES

PLATE 28

Fig. 1. A normal olive-gray fructification on the underside of pine flooring in a warehouse for tarred roofing paper in eastern Texas. Photographed in a fresh condition.

Fig. 2. A fresh olive-gray fruit-body from the underside of Douglar fir flooring in an open lumber storage shed at Seattle, Washington. (See also Pl. 29, Fig. 1.)

Fig. 3. Section of fructification shown in Fig. 2, showing well-developed pores about 1 cm. long.

Fig. 4. Abortive brownish-black fructification on pine partition separating a servants' toilet from an adjoining woodshed at Gainesville, Florida. Fungus fruiting in the partially illuminated shed. Note the thick subiculum of vertically arranged hyphae which become very conspicuous when the fungus cracks from drying.

Fig. 5. Abortive brown liver-like fruit-body from the upper surface of pine floor planks in a cotton warehouse in Mississippi.

Fig. 6. Abortive thin brown fruit-body on pine wall sheathing in a small workshop at Riderville, Alabama.

Fig. 7. Old blackish-brown fructification on the reverse side of sheathing similar to that shown in Fig. 6.

Fig. 8. A thin young cinnamon-buff fruit-body on the foundation timbers in one of the temporary government buildings in Washington, D. C. This building was erected during the recent war and has already failed at several points as a result of this infection.

PLATE 29

Fig. 1. An old dry fruit-body on the underside of Douglas fir flooring in an open lumber shed at Seattle, Washington.

Fig. 2. White strand-like mycelium and small white to brown rhizomorphs on the underside of pine flooring in a warehouse for tarred roofing paper in eastern Texas. (See also Pl. 28, Fig. 1.)

Fig. 3. Large brownish rhizomorphs closely embedded in a mycelial sheet on the under surface of a pine floor board. This floor was laid on 2″ x 4″ timbers placed on edge on a brick pavement in the basement of a church at Natchez, Mississippi.

Fig. 4. Cross section of large rhizomorph under low magnification. The openings toward the center are conducting tubes.

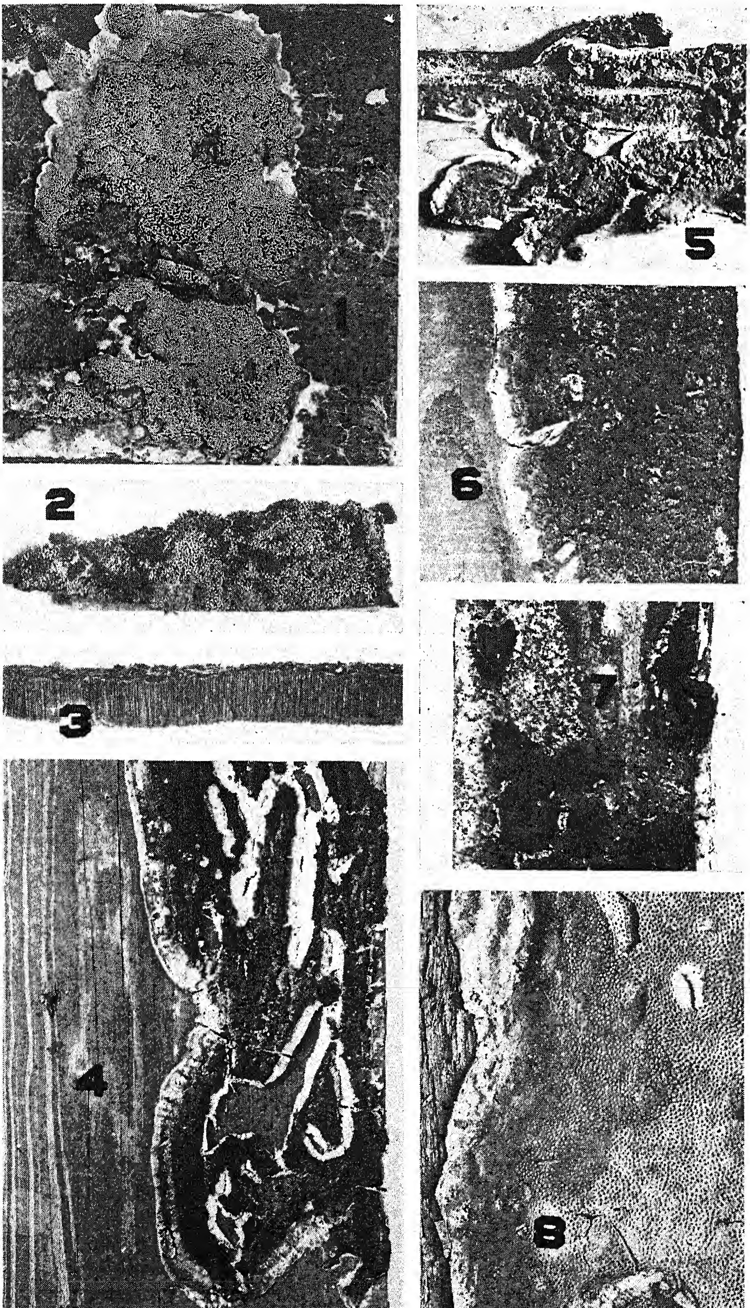
Fig. 5. Central portion of same rhizomorph under higher magnification than in Fig. 4.

Fig. 6. Spores of *Poria incrassata.*

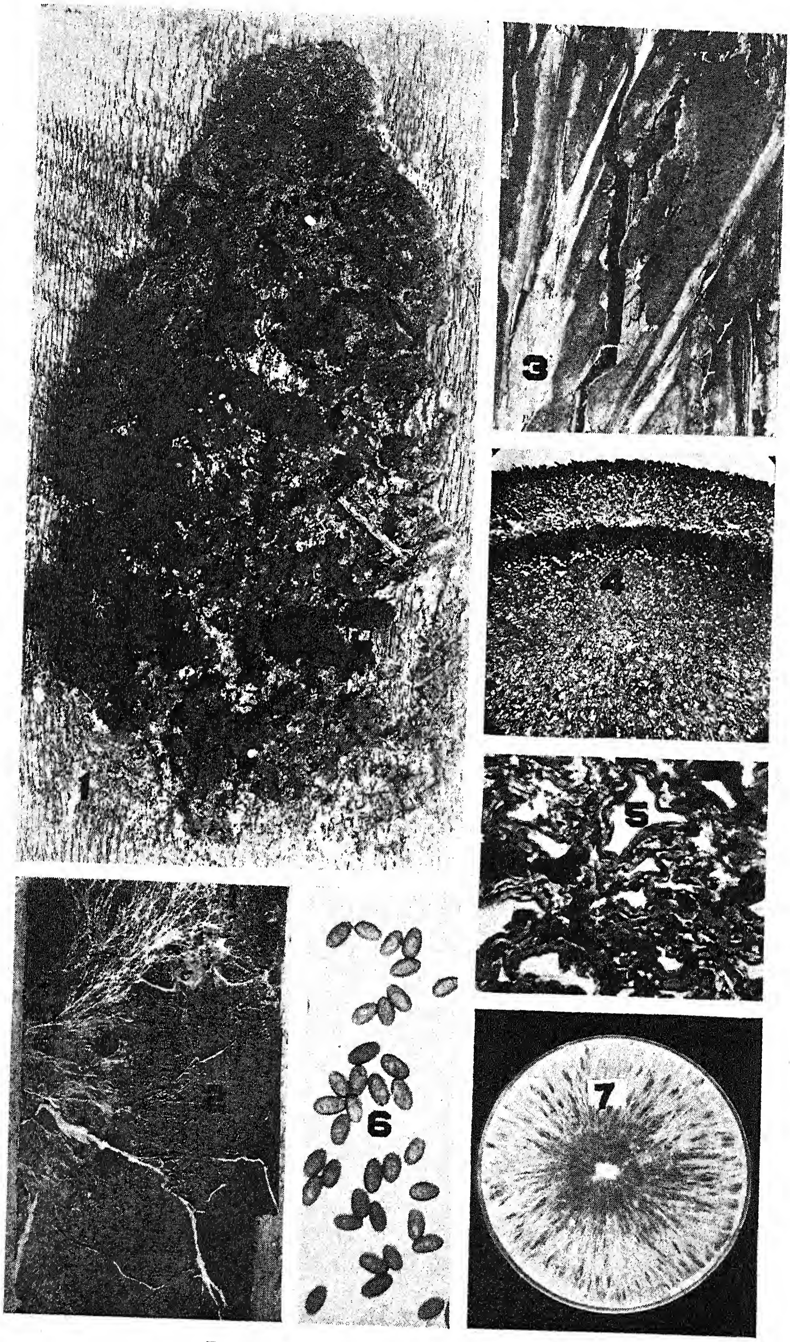
Fig. 7. A Petri-dish culture of *Poria incrassata* grown for 22 days at 30° Centigrade.

PLATE 30

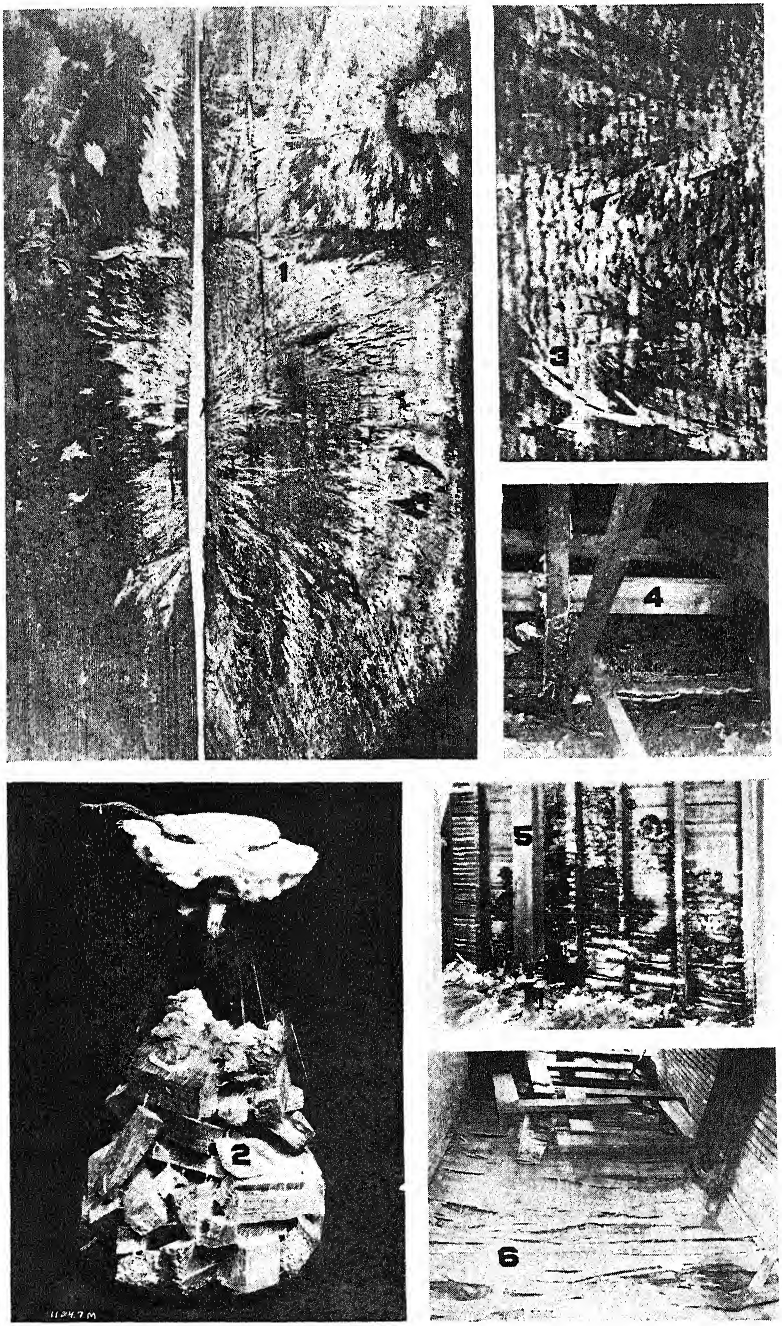
Fig. 1. Heart cypress shingles showing an abundance of white to yellowish fan-shaped mycelium. The fungus coated the shingles throughout the bundles



Poria incrassata (B. & C.) Burt



PORIA INCRASSATA (B. & C.) BURT



Poria incrassata (B. & C.) Burt

and in a short time totally destroyed 30 to 40 thousand shingles at a retail lumber yard in Houston, Texas.

Fig. 2. A pure culture of *Poria incrassata* in a 2-liter Erlenmeyer flask prepared for testing the durability of various woods. Note the strandlike growth of the fungus.

Fig. 3. Mycelium on the surface of tarred roofing paper stored over an infected floor. The fungus invaded the lower end of the rolls and destroyed a considerable amount of the stock.

Fig. 4. An infected pine post and stringers in an open lumber shed at a retail lumber yard in Birmingham, Alabama. The fungus has run upward to the second bin, a distance of 5 to 6 feet. New sound planks were, in some cases, piled in close contact with the diseased posts. The infection will thus be transmitted in the course of a few days to every plank in the pile. The losses on this yard amounted to $1,000 to $2,000.

Fig. 5. Infection within a plastered partition wall in a church at Kansas City, Missouri, after one side of the wall has been torn away. A large area of flooring laid over cement was also rotted.

Fig. 6. Pine floor in the basement of a church in Natchez, Mississippi. The floor is laid on 2″ x 4″ pine stringers placed edgewise and resting on a brick pavement. This timber gave very short service.

FLORIDA FUNGI—I

W. A. MURRILL

A number of fungi were picked up by me at various places in Florida during March, 1923, when I was fortunate enough to be able to make a collecting trip through portions of the state. As the season was very dry, few fleshy fungi were seen, even in the hammocks, where most of my time was spent. Instead of repeating the word "hammock" in my locality notes, the reader will please understand it after most of the places mentioned, like Deering, Snapper Creek, Brickell, Royal Palm, and Brooksville. At Tarpon Springs and New Smyrna the collecting grounds were mostly dense woods along streams or in low places. The Florida pine lands were much too dry when I saw them to yield anything of special mycological interest.

AGARICACEAE

DROSOPHILA APPENDICULATA (Bull.) Quél. Brooksville.
LENTINUS CRINITUS (L.) Fries. Brooksville, New Smyrna, Royal Palm.
LENTINUS STRIGOSUS (Schw.) Fries. Brooksville.
LENTINUS VELUTINUS Fries. Brooksville.
PLICATURA LATERITIA (Berk. & Curt.) Murrill. Tarpon Springs.
PLUTEUS CERVINUS (Schaeff.) Quél. Brickell, Brooksville.
SCHIZOPHYLLUS ALNEUS (L.) Schroet. Tarpon Springs.

PILEATE POLYPORACEAE

BJERKANDERA ADUSTA (Willd.) P. Karst. Brooksville, New Smyrna.
CERENELLA FARINACEA (Fries) Murrill. New Smyrna, Royal Palm.
CERENELLA RAVENELII (Berk.) Murrill. New Smyrna, Royal Palm.
CORIOLELLUS SERIALIS (Fries) Murrill. Tarpon Springs.
CORIOLOPSIS CROCATA (Fries) Murrill. Brickell, Royal Palm.
CORIOLOPSIS RIGIDA (Berk. & Mont.) Murrill. Royal Palm.
CORIOLUS BIFORMIS (Klotsch) Pat. Brooksville.
CORIOLUS BRACHYPUS (Lév.) Murrill. Deering, Snapper Creek.
CORIOLUS MAXIMUS (Mont.) Murrill. Brickell.
CORIOLUS MEMBRANACEUS (Sw.) Pat. Deering, New Smyrna.
CORIOLUS NIGROMARGINATUS (Schw.) Murrill. Brooksville.
CORIOLUS OCHROTINCTELLUS Murrill. Deering. Apparently an abnormal, stipitate form of this Mississippi species.

CORIOLUS PINSITUS (Fries) Pat. Brickell, Deering, Snapper Creek.

CORIOLUS SERICEOHIRSUTUS (Klotsch) Murrill. On red cedar at New Smyrna. Very nearly related to *C. pinsitus*.

CORIOLUS SECTOR (Ehrenb.) Pat. Brooksville, Deering, Snapper Creek, Tarpon Springs.

CORIOLUS VERSICOLOR (L.) Quél. Brooksville, New Smyrna.

CYCLOPORELLUS IODINUS (Mont.) Murrill. Brooksville, Royal Palm, Snapper Creek.

DAEDALEA AMANITOIDES Beauv. Brooksville.

DAEDALEA CONFRAGOSA (Bolt.) Pers. Brooksville.

ELFVINGIA TORNATA (Pers.) Murrill. Brooksville, Deering, Snapper Creek.

ELFVINGIELLA MARMORATA (Berk. & Curt.) Murrill. On decayed spot in trunk of living live-oak on a street in Brooksville.

FOMES ROSEUS (Alb. & Schw.) Cooke. On red cedar at New Smyrna.

FOMITELLA SUPINA (Sw.) Murrill. Brooksville, Deering, Royal Palm.

GANODERMA SUBINCRUSTATUM Murrill. Coconut Grove.

GANODERMA SULCATUM Murrill. Abundant on cabbage palmetto at New Smyrna and also found on the same host near Tarpon Springs.

GLOEOPHYLLUM HIRSUTUM (Schaeff.) Murrill. Royal Palm, Tarpon Springs,

GLOEOPHYLLUM STRIATUM (Sw.) Murrill. Brooksville.

HAPALOPILUS GILVUS (Schw.) Murrill. Brooksville, Deering, Tarpon Springs.

HAPALOPILUS LICNOIDES (Mont.) Murrill. Brooksville, Deering, Royal Palm, Snapper Creek.

INONOTUS FRUTICUM (Berk. & Curt.) Murrill. Deering.

LENZITES BETULINA (L.) Fries. Brooksville.

POGONOMYCES HYDNOIDES (Sw.) Murrill. Brickell, Brooksville, Deering, Royal Palm, Snapper Creek, Tarpon Springs.

POLYPORUS ARCULARIUS (Batsch) Fries. Brooksville, New Smyrna.

PYCNOPORUS SANGUINEUS (L.) Murrill. Brooksville, Deering, New Smyrna, Royal Palm, Snapper Creek.

PYROPOLYPORUS CALKINSII Murrill. Resupinate form on live-oak near Tarpon Springs.

PYROPOLYPORUS DEPENDENS Murrill. Common on live-oak trunks at Brickell and Deering.

PYROPOLYPORUS LANGLOISII Murrill. Snapper Creek. Apparently a form of this Louisiana species which dried up and became indurate before fully expanding.

Trametes amygdalinus (Berk. & Rav.) comb. nov. (*Polyporus amygdalinus* Berk. & Rav.; Berk. Grevillea 1: 49. 1872.) Described from South Carolina on oak, and sent to me in fine examples from Alabama by Dr. R. P. Burke. I found it on old live-oak logs in the big hammock at Brooksville. *Trametes cubensis* (Mont.) Sacc. is probably its nearest relative. The beginner might possibly confuse it with *Laetiporus sulphureus,* but it is not brilliantly colored and the context is not rigid when dry.

NEW YORK BOTANICAL GARDEN

CORDYCEPS SPHINGUM (SCHW.) IN THE PHILIPPINES

Albert W. C. T. Herre

The accompanying figures are of a sphingid moth belonging to the genus *Acosmeryx* Boisd., according to Mr. W. Schultze, entomologist of the Bureau of Science. The moth is a mere chitinous shell, its singular appearance being due to the growth of a well-known insect-destroying fungus, *Cordyceps sphingum*. The long spikes protruding in every direction from the moth are the ascophores, or fruiting branches, of the fungus. Through the kind-

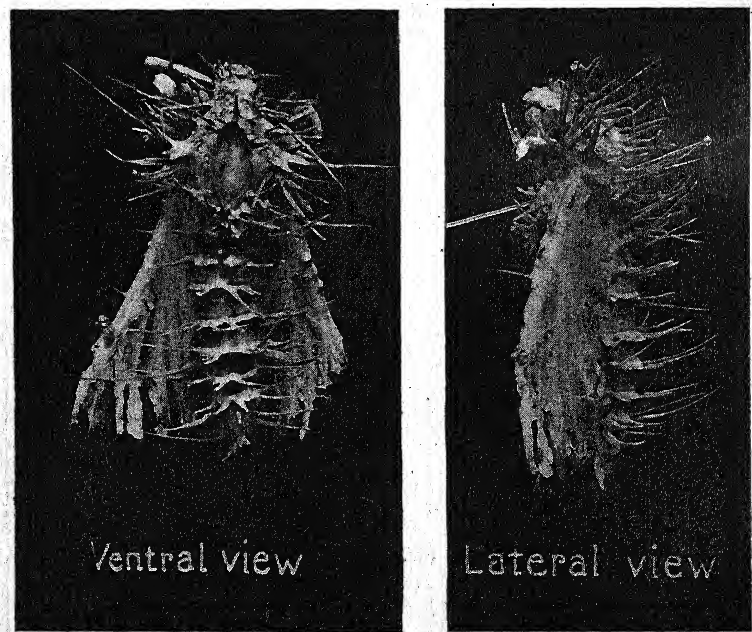


Fig. 1. *Cordyceps sphingum.*

ness of Father Sanchez, S. J., the Bureau of Science has received a specimen collected at Camp 2, on the Benguet road, Mountain

Province, by Señor Ferreira. It is thoroughly typical, agreeing in all essentials with Tulasne's [1] figures.

This species occurs on sphingid moths and on Orthoptera (locusts and katydids) from North Carolina to Brazil, being common in the West Indies. It has also been reported from Darjeeling, India, on two moths of the *Noctuidae*, *Spirama retorta*, and a species of *Hypena*. European records from Scotland and Switzerland are more or less doubtful, as are certain records from the northern United States. As a general rule mycologists have called every Isaria-like fungus parasitic on a moth *Isaria* or *Cordyceps sphingum*, without comparison with authentic herbarium material.

The occurrence of this striking-looking insect-destroying fungus in the mountains of Northern Luzon adds greatly to our knowledge of its distribution and is a notable find.

BUREAU OF SCIENCE,
MANILA, P. I.

[1] Tulasne, Sel. Fung. Carpol., 3 (1865), 12, *Tab. I, figs. 1 and 2.*

INDEX TO VOLUME XV

New names and the final members of new combinations are in **bold face type**